FORTIFIED FISH SAUCE: A NOVEL MEANS OF IMPROVING THIAMIN STATUS IN RURAL CAMBODIA

by

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Abstract

Background: Infantile beriberi, a consequence of maternal thiamin deficiency, is not uncommon in Cambodia. The Cambodian diet consists largely of thiamin-poor, polished white rice and contains few thiamin-rich foods.

Objectives: 1) Determine the thiamin status, assessed by erythrocyte thiamin diphosphate concentration (eTDP), among Cambodian women of childbearing age; 2) develop a stable and acceptable thiamin-fortified fish sauce; and 3) test the efficacy of thiamin-fortified fish sauce to increase eTDP among two groups in rural Cambodia: i) women and their youngest child aged 12-59 mo, and ii) pregnant and lactating women and their breastfed infants.

Methods: eTDP was determined in samples of women 20-45 y from Prey Veng (n=121) and Phnom Penh (n=117), Cambodia, and for comparison, Canada (n=47). Thiamin stability in fish sauce was assessed under various conditions, and acceptability was determined through sensory evaluation. Women (18-45 y; n=354, 276 non-pregnant and non-lactating, and 78 pregnant and lactating) and their families in Prey Veng, Cambodia were randomized to: control, low (LC, 2 g/L) or high (HC, 8 g/L) concentration thiamin-fortified fish sauce.

Results: Mean ± SD eTDP was significantly lower among women in Prey Veng (149 ± 36 nM) than Phnom Penh (156 ± 32 nM), which, in turn, was lower than in Vancouver, (179 ± 37 nM; P<0.05). Thiamin was stable in fish sauce, and accepted by Cambodian women. Among non-pregnant women, endline eTDP (mean; 95% CI) was higher among those in LC (232; 220, 244 nM) and HC (231; 219, 244 nM) groups versus control (175; 163, 188 nM; P<0.001). Similar results were found in children (P<0.05). Endline eTDP was higher among lactating mothers in LC (276; 246, 306 nM) and HC (238; 207, 268 nM) groups versus control (194; 163, 224 nM; P<0.05). Infants of mothers in HC group had higher eTDP (257; 215, 298 nM; P<0.05) versus LC (205; 175, 235 nM) and control (181; 153, 210 nM) groups.

Conclusions: Thiamin-fortified fish sauce is an efficacious means of improving dietary thiamin intake and biochemical thiamin status in rural Cambodia, and as such highlights downstream potential to reduce mortality from a totally preventable disease, infantile beriberi.

Preface

This research is the result of a collaborative effort. Though I took the lead on study design, protocol preparation, data collection, statistical analysis, and dissemination, this research would not have been possible without the support of many faculty and staff from the University of British Columbia, Helen Keller International, and the Cambodian Ministry of Health and Ministry of Planning.

This research grew out of a research partnership between the University of British Columbia and Helen Keller International – Cambodia, and I gratefully acknowledge the contributions of my colleagues. I led a successful grant application to Grand Challenges Canada (Stars in Global Health) and developed study protocols in collaboration with my doctoral supervisory committee members from the University of British Columbia, Drs. Tim Green, David Kitts, Eunice Li-Chan, Larry Lynd, and Judy McLean, Helen Keller International partners Mr. Aminuzamman Talukder, Mr. Hou Kroeun, Ms. Ly Sokhoing, Dr. Ame Stromer, and Mr. Keith Porter, and Cambodian government partners Dr. Prak Sophonneary from the Ministry of Health and Mr. Mam Borath from the National Sub-Committee for Food Fortification, Ministry of Planning. I oversaw data collection, quality control and data management in-country (conducted by the Cambodia-based research team) with Mr. Sim Chhoeun, Mr. Phon Phearom, and Mr. Rem Ngik (Helen Keller International). Laboratory assessment of eTDP was conducted by Mr. Benny Chan (UBC), and breast milk thiamin was analyzed by Drs. Daniela Hampel and Lindsay Allen (Agricultural Research Service, United States Department of Agriculture, University of California, Davis). I performed all data analysis and writing in close collaboration with my supervisory committee.

All studies documented in this dissertation obtained ethics approval in both Canada and Cambodia: the University of British Columbia Clinical Research Ethics Board (H12-02847, H13-01319, H14-02173, H14-00103), the University of British Columbia – Children's and Women's Health Centre of British Columbia Research Ethics Board (CQ14-0204/H14-01654), and the Cambodian National Ethics Committee for Health

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List of Abbreviations

AI	adequate intake
ANOVA	analysis of variance
BMI	body mass index
CI	confidence interval
CV	coefficient of variation
d	day(s)
EAR	estimated average requirement
EDTA	ethylenediaminetetraacetate
eTDP	erythrocyte thiamin diphosphate
GLM	general linear model
h	hour(s)
HC	high concentration thiamin-fortified fish sauce
HPLC-FLD	high performance liquid chromatography with fluorescence detector
IFA	iron folic acid supplements
ITT	intent-to-treat analysis
LC	low concentration thiamin-fortified fish sauce
LSD	least significant difference
min	minute(s)
mo	month(s)
NaFeEDTA	ferric sodium ethylenediaminetetraacetate (iron fortificant)
NGO	non-governmental organization
NIPH	National Institute of Public Health (Phnom Penh, Cambodia)

NSCFF	National Sub-Committee for Food Fortification (Phnom Penh, Cambodia)
NTD	neural tube defect
PPS	probability proportional to size sampling
RDA	recommended dietary allowance
SD	standard deviation
TDP	thiamin diphosphate
THCl	thiamin hydrochloride
TMP	thiamin monophosphate
TTP	thiamin triphosphate
UBC	University of British Columbia (Vancouver, Canada)
UL	tolerable upper intake level
UN	United Nations
USDA/ARS	Agricultural Research Service, United States Department of Agriculture
wk	weeks(s)
y	year(s)

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Chapter 1: Introduction, literature review, and research objectives and hypotheses

1.1 Introduction

Infantile beriberi, a disease caused by thiamin (vitamin B_1) deficiency, remains a public health concern in Cambodia and other parts of Southeast Asia. Infantile beriberi usually presents during the exclusive breastfeeding period and without treatment commonly results in death within hours of clinical presentation. The Cambodian diet is low in thiamin, consisting mostly of thiamin-poor, polished white rice. Low maternal thiamin intake directly impacts breast milk thiamin content, putting exclusively breastfed infants at risk of thiamin deficiency and infantile beriberi. Therefore, maternal thiamin intake must be improved to prevent infantile beriberi. Food fortification is an inexpensive, sustainable, and passive means of improving the diet when micronutrients are lacking. Fish sauce could be an ideal vehicle for thiamin fortification as it is a popular condiment consumed by most Cambodians, and is already being used for iron fortification.

What follows is a review of the literature, followed by four chapters outlining the results of my doctoral research. Chapter 2 reports results of a cross-sectional study highlighting the low biochemical thiamin status among rural Cambodian women of childbearing age. In Chapter 3, I detail the formulation and evaluation of thiamin-fortified fish sauce, reporting on thiamin stability and consumer acceptability. Chapters 4 and 5 report the results of two concurrent double-blind randomized controlled efficacy trials of thiamin-fortified fish sauce. The first included non-pregnant, non-lactating women of childbearing age (18-45 y) and their youngest children 12-59 mo, and the second included a group of

pregnant and lactating women (18-45 y) and their newborn infants. The results of these chapters, as well as next steps and future directions for further research, are discussed in Chapter 6.

1.2 Literature review

1.2.1 Cambodia

Cambodia is a rice-growing country in Southeast Asia, bordering Thailand, Vietnam, and Laos (1). Home to 13.4 million people, 80% of Cambodians live in rural areas; the capital city of Phnom Penh only has a population of 1.3 million people (1). Cambodia has a tumultuous history. Cambodia was a French colony until it gained independence in 1953. In 1975, Pol Pot led the Khmer Rouge regime (known locally as *Pak Kommunis Kampuchea*) in overthrowing the government. Over the next four years (1975-1979) the ensuing genocide resulted in an estimated two million deaths (approximately one quarter of the Cambodian population) both from execution and indirectly due to starvation and disease (2). Cambodia became a constitutional monarchy after the first free elections were held under the supervision of the United Nations Transitional Authority in 1993 (1). Despite political stability since 1993, Cambodia remains one of the least economically developed countries in Asia, with a per capita gross domestic product of ~US$800, and an estimated 28% of the population living under the poverty line (1).

Small-scale subsistence rice farming is the main economic activity in Cambodia (1), so food security is tightly linked with rice production. In the wet season (May to October), heavy rains provide ideal rice-producing conditions, while extremely dry conditions and

lack of irrigation limit rice production in the dry season (<10% of total Cambodian production; November to February) (3). Beyond household consumption, the marketing of rice for cash as well as other commodities make rice the major driver of household economic status, especially around harvest at the end of the wet season (3). Food insecurity, defined as the inability to acquire nutritionally adequate, safe, and acceptable foods in a socially acceptable way (4) is common in Cambodia. A recent survey of 900 households in Prey Veng province, Cambodia found that only 18% of households were food secure (5). The same study highlighted low dietary diversity: the mean Household Dietary Diversity Scale score (out of 12) was 4.7 (5). Both food insecurity and poor dietary diversity increase the risk of malnutrition and, in turn, poor health outcomes (6). In Cambodia, malnutrition typically manifests as 'hidden hunger', a term coined to refer malnutrition caused by micronutrient deficiencies while energy intake is adequate (7). Recent analysis of 2011 Food and Agriculture Organization food balance sheets estimate that milled (white, polished) rice makes up 1520 of the 2411 kcal/day per capita, or 63% of daily energy intake (8), so while people are not hungry in the traditional sense (inadequate energy intake), the low micronutrient content of rice means that micronutrient deficiency diseases remain prevalent.

One commonly employed malnutrition-related health indicator is childhood mortality; indeed Sustainable Development Goal 3.2 aims to end all preventable mortality of newborns and children under 5 years by 2030 (9). In 2013, post-neonatal mortality (death between 29-364 days) was 15.6 deaths per 1,000 live births in Cambodia (10). While high, this is a vast improvement as infant mortality (defined as death before the first

birthday) was 95 deaths per 1,000 live births in Cambodia in 2000 (1). However, this is higher than both the 2013 regional estimate of 7.9 deaths per 1,000 live births in Southeast Asia, and the current global estimate of 13.2 deaths per 1,000 live births (10). Therefore, there is room for improvement in infant mortality prevention in Cambodia. A portion of these infant deaths in Cambodia can be attributed to infantile beriberi (11,12), a 'hidden hunger' disease in infants caused by thiamin (vitamin B_1) deficiency.

1.2.2 Thiamin

Thiamin is an essential micronutrient required for normal human metabolism (13). Thiamin is found in four forms: thiamin, thiamin monophosphate (TMP), thiamin diphosphate (TDP), and thiamin triphosphate (TTP) (see **Figure 1-1)** (14). TDP is the biologically active derivative of thiamin (see

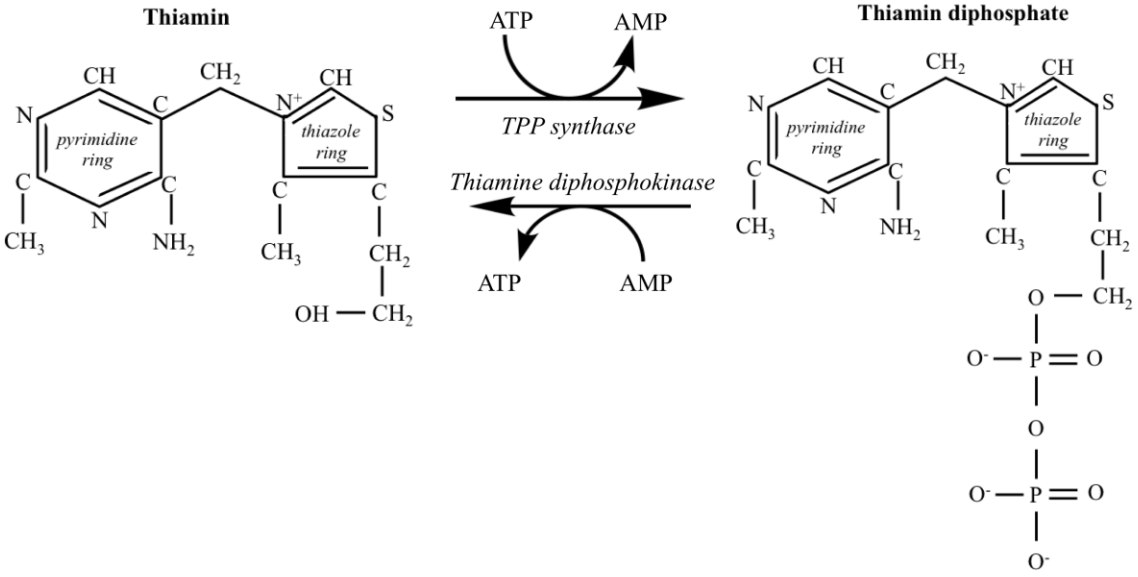
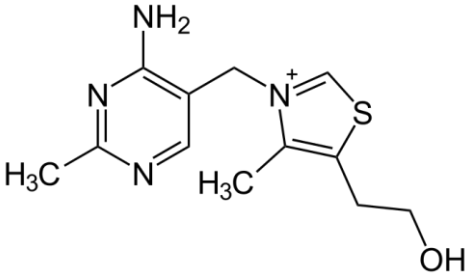


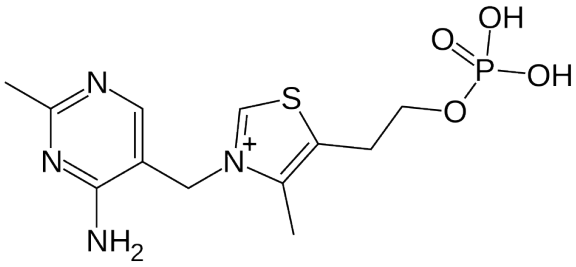
Figure 1-2 for conversion). TDP plays a major role in glucose metabolism and cellular energy generation (13), and is also responsible for maintaining normal mitochondrial structure and function (15). TDP is a co-factor for 24 metabolic enzymes; of key

importance are pyruvate dehydrogenase and α-ketoglutarate dehydrogenase, which aid in the formation of acetyl-CoA and succinyl-CoA, respectively, for use in the Krebs cycle (14,16). TDP is a co-factor with transketolase in the pentose phosphate pathway, where it forms intermediates that can be channeled into the glycolysis pathway for energy production (13,17,18). **Figure 1-3** summarizes the role of TDP in these pathways. As a co-factor in these cellular energy-forming pathways, thiamin is required for any conversion of glucose, or simple carbohydrates, to useable energy in humans (15). TDP also plays a major role in the central nervous system, modulating neuronal and neuromuscular transmissions (19).

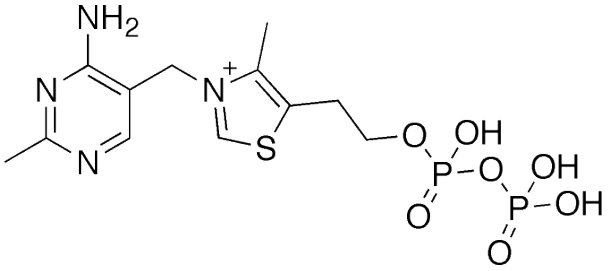
Thiamin



Thiamin monophosphate



Thiamin diphosphate



Thiamin triphosphate

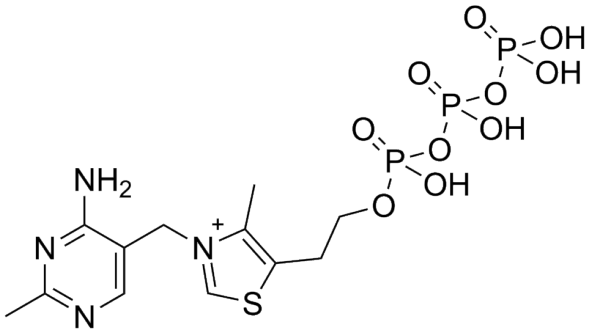


Figure 1-1: Chemical structures of thiamin vitamers thiamin, TMP, TDP, and TTP (*public domain*).

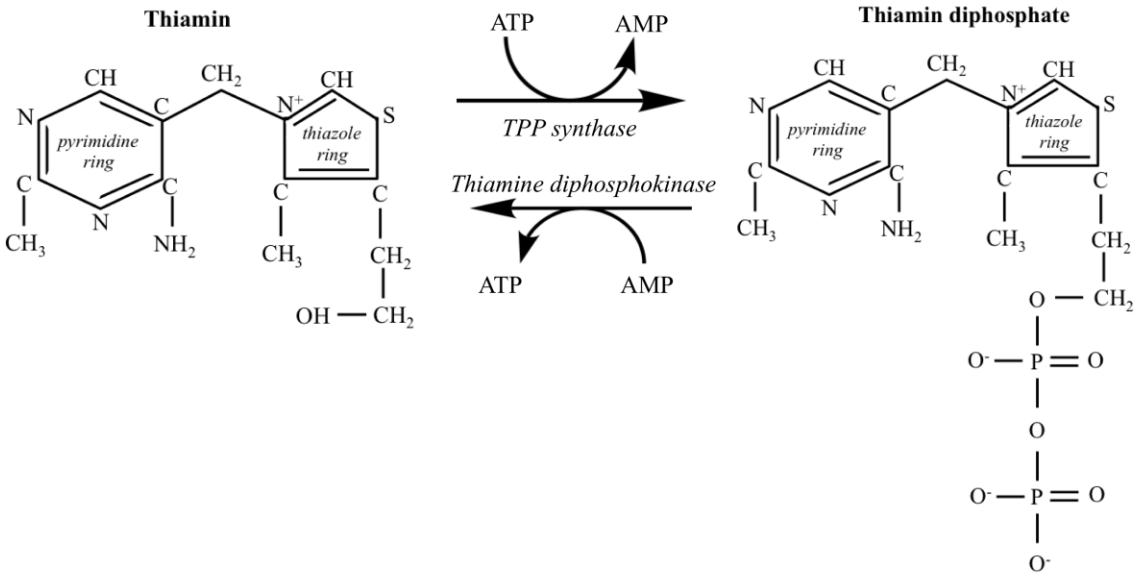


Figure 1-2: Conversion between thiamin and the biologically active derivative, thiamin diphosphate.

1.2.2.1 Thiamin absorption, transport, and metabolism

Thiamin is a water-soluble vitamin and, as such, is not stored long-term in any tissue (13). Free thiamin is absorbed in the small intestine via two concentration-dependent mechanisms: below 1 μM, thiamin is transported through an active, carrier-mediated, sodium-dependent mechanism; at higher concentrations thiamin is absorbed via passive diffusion (20). While the majority of thiamin is absorbed in the jejunum (13) thiamin is absorbed throughout the gastrointestinal tract (20); colonic microbiota also synthesize considerable thiamin and TDP, both of which are absorbed via a sodium-independent, pH-sensitive, carrier mediated process in the colon (15). Once absorbed, phosphorylated thiamin undergoes transport to the liver via portal blood (13), mediated by SLC19A2 or SLC19A3 (14). Excess non-protein-bound plasma thiamin is rapidly dephosphorylated, filtered by glomerulus, and cleared by the kidneys (21). Little is known about the transport and incorporation of thiamin into breast milk.

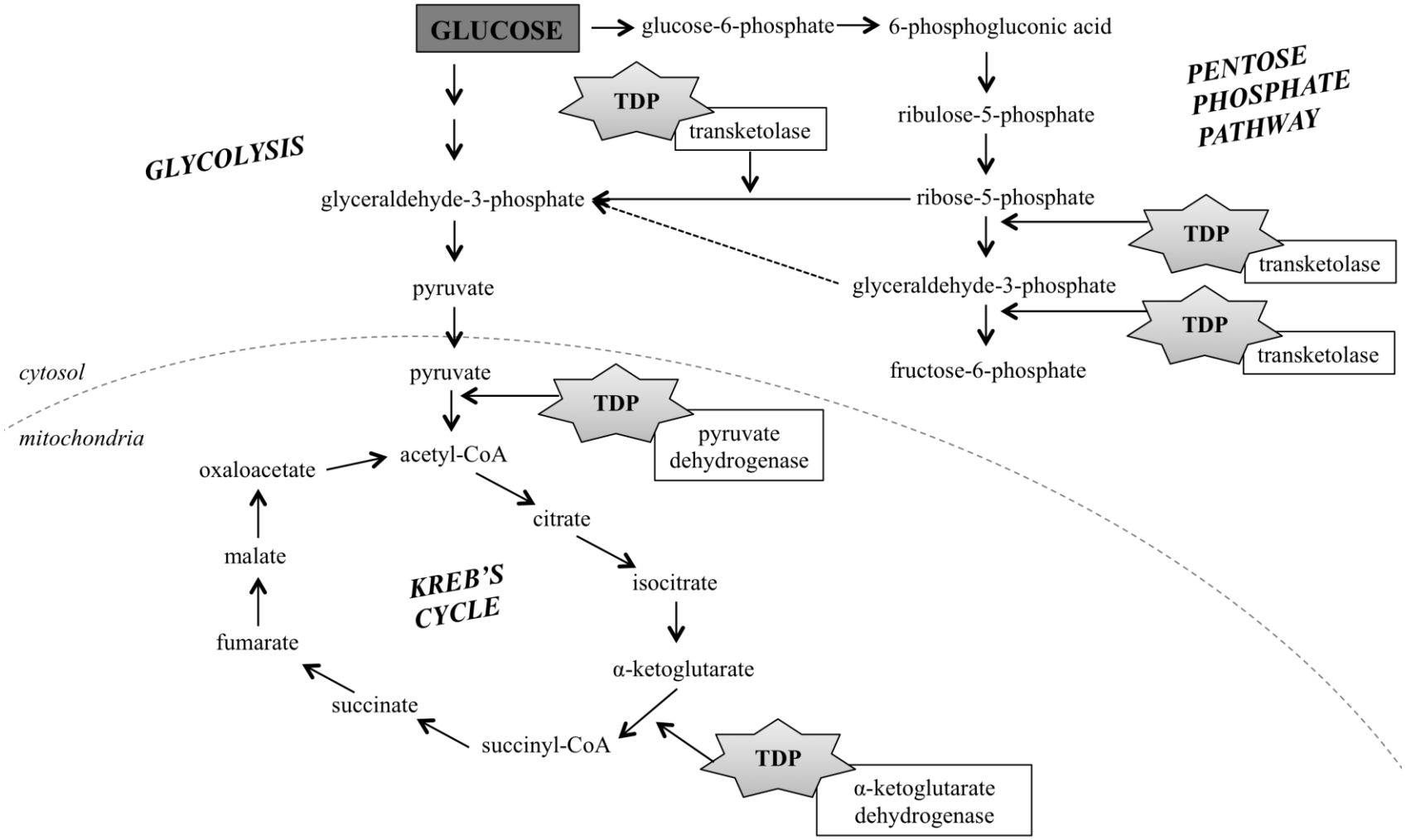


Figure 1-3: Thiamin diphosphate (TDP) as a co-factor in cellular energy-producing pathways glycolysis, the Kreb's Cycle, and the Pentose Phosphate Pathway.

TDP is the most abundant derivative in human tissue, making up nearly 90% of total body thiamin (20). Healthy adults have an estimated total body thiamin content of 25-30 mg (13), found mostly in the brain and skeletal muscle (22). At high doses only a small portion of thiamin is absorbed (23), and of that little is retained (21). For instance, a single oral dose of thiamin higher than approximately 2.5 to 5 mg has been shown to go largely unabsorbed in healthy adults (20). An experimental thiamin supplementation study among six healthy, thiamin-replete Canadian males in the 1960s found 21% absorption of a 2.5 mg thiamin dose, but decreased absorption at higher doses: 9% and 4% absorption of 5 mg and 20 mg doses, respectively (23). Of the thiamin that is absorbed, little is retained. An Australian study found that, among 6 test volunteers (22-43 y; n=3 men and 3 women) who consumed a 11 mg dose of thiamin hydrochloride, there was rapid active excretion of excess plasma thiamin in the urine (21). However, rapid metabolism and turnover of this vitamin, with a biological half-life between 9 and 18 days (24), necessitates regular dietary intake (13).

1.2.3 Dietary thiamin requirements

1.2.3.1 Women of childbearing age

The Institute of Medicine's recommended dietary allowance (RDA) for thiamin was established based on few studies with small sample sizes using outdated analytical techniques (studies conducted between 1940s-80s) (18). The heaviest weighting of evidence for the thiamin DRIs was placed on a thiamin depletion-repletion study conducted among only seven men (age unknown) in a metabolic unit in the late 1970s, using urinary thiamin excretion as the biomarker (18,25). As such, the DRIs should be

considered under this context. The EAR and RDA for thiamin for women aged 19-50 y is 0.9 mg/d and 1.1 mg/d, respectively (18), however the Canadian Community Health Survey data indicate that usual thiamin intake among women of childbearing age is much higher at 1.48 mg/d (aged 19-50 y) (26). During pregnancy and lactation the DRIs were calculated to allow for a 10% increase for higher energy utilization in pregnancy and increased energy costs for milk production in lactation, increasing the RDA to 1.4 mg/day (18). During the third trimester of pregnancy, thiamin is preferentially sequestered by the fetus (27): umbilical cord blood of thiamin-replete mothers has up to three times higher thiamin concentrations than maternal blood at birth (28). This sequestration highlights the importance of adequate maternal thiamin intake, especially during the latter stages of pregnancy, to allow for a build up of infant stores *in utero*. During lactation, increased maternal thiamin requirements ensure adequate growth and development of the infant (29,30). Lactating women transfer an estimated 0.16 mg thiamin daily to breast milk, and additional thiamin is required by the mother herself to meet increased energy needs for milk production (18).

There is no tolerable upper intake level (UL) for thiamin because there have been no reports of adverse effects of excess thiamin intake (17,18), probably because absorption declines rapidly at dietary intakes at and above 5 mg (20,23) and excess thiamin is excreted in urine (21). Indeed, some daily over-the-counter supplements can contain 50 mg thiamin (18) or more, greatly exceeding the RDA.

Southeast Asian-specific dietary thiamin recommendations are identical to those noted above, except for needs during lactation (18,31). The Southeast Asian RDA for lactating women is 1.5 mg/day: in addition to the 1.1 mg/day for women of childbearing age, increased thiamin needs of 0.2 mg (transferred to milk) and 0.2 mg (increased needs for for milk production) were estimated (31). However, the Institute of Medicine recommends 1.4 mg/day as it estimates only 0.1 mg/day requirements for milk production (18).

1.2.3.2 Infants

Since there have been no documented reports of full-term, exclusively breastfed American or Canadian infants developing beriberi, the Institute of Medicine set an adequate intake (AI) for thiamin for infants aged 0-6 months using observed thiamin intakes by exclusively breastfed infants consuming milk from healthy, purportedly thiamin-replete mothers (18). AIs are developed when there is not sufficient evidence available to establish an estimated average requirement (EAR) and RDA, and are expected to meet or exceed the needs of individuals in that age group (18). Using an observed mean thiamin concentration of 210 μg/L in milk produced by well-nourished American mothers (*n*=24) in the 1980s (32–34), and estimating infants of this age consumed 780 mL milk/day, the Institute of Medicine set the thiamin AI for infants aged 0-6 mo at 200 μg thiamin/day (18). This AI is contentious due to the small sample size of women used to set this AI, and likely suboptimal (outdated) analytical techniques (35); see *1.2.6.2 Breast milk*, below.

1.2.4 Dietary thiamin sources and anti-thiamin factors

Thiamin is found in a wide range of foods, but is particularly high in whole grain products, legumes, soy, beans, pork, and organ meats (13). In North America, wheat flour is enriched with thiamin to offset processing losses (36,37), and other foods, including ready-to-eat breakfast cereals, are fortified with thiamin voluntarily. The thiamin content of these high-thiamin foods (and thiamin-poor alternatives) can be found in **Table 1-1**.

Table 1-1: Thiamin content of select foods

Food	Thiamin content (mg/100g)[1]
Kellogg's Corn Flakes (fortified breakfast cereal)	1.34
Pork loin (cooked)	0.599
Bread	
Whole wheat bread	0.522
White bread (thiamin enriched)	0.510
Beef liver (broiled)	0.194
Tofu (fried)	0.170
Red lentils (boiled)	0.169
Kidney beans (cooked)	0.160
Beef kidney (simmered)	0.160
Rice	
Brown rice (cooked)	0.102
White rice (cooked)	0.020

[1] Values derived from National Nutrient Database for Standard Reference (Release 28, software v.2.3.4.2), United States Department of Agriculture Agricultural Research Service.

Thiamin is sensitive to neutral and alkaline pH, oxygen, light, and heat (38), as well as exposure to thiaminases (enzymes that degrade thiamin) (39). In addition, thiamin absorption and metabolism can be disrupted by the presence of anti-thiamin factors. There are three types of anti-thiamin factors: thiaminase, polyphenols (namely tannins), and catechols (39). Thiaminase, an enzyme that degrades thiamin, was the first 'antivitamin' to be discovered, in the 1930s (40). Found in several fish species as well as clams and crabs, thiaminase cleaves thiamin at its methylene linkage (39,40). However,

thiaminase is heat-liable, so thiaminase-containing foods are only a risk when consumed raw (13). Unfortunately, *prahoc,* a fermented fish paste that is often viewed as the second most important food in Cambodia after rice, is eaten both cooked and raw (41). Gallic acid-containing tannins, such as those found in tea and betel nuts, destroy thiamin under neutral and basic conditions (39). The anti-thiamin effects of these tannins can be prevented by delaying contact with tannins (i.e. consuming tea hours after a thiamin-containing meal, rather than during) (42), or by cooking with ascorbic acid to lower pH (39). In Cambodia, betel nut chewing has lost popularity due to permanent staining of teeth, however some women chew betel during pregnancy to alleviate morning sickness (43). Finally, catechols, found in green coffee beans, sunflower seeds, and bracken fern also have anti-thiamin activity (40), but these are not common in the Cambodian diet.

1.2.5 Rice as a dietary staple

As shown in **Table 1-1**, white rice is a poor source of thiamin because thiamin is found only in the outer husk and bran, the vast majority of which is removed during the milling process (44). Further polishing removes any remaining traces of thiamin from the rice as only the thiamin-poor endosperm remains (45). This is problematic because in most rice-consuming cultures globally, well-milled, polished white rice is preferred (44,46) for several reasons: organoleptic qualities, white rice as a status symbol (45), and because removal of the lipid-rich outer bran increases shelf-life (44). In Cambodia, brown rice is a food traditionally consumed by prisoners and livestock (i.e. fish, pigs); as such, white rice is preferred.

Parboiling, a process of soaking and steaming rice before milling, is one means of improving the thiamin content of white rice (44). While originally employed to aid in de-husking (bran is softer to grind through hand milling), this process forces thiamin and other B vitamins from the bran into the endosperm during the soaking step (45). Unfortunately parboiling rice is not commonplace in Asia because traditionally this process resulted in a musty aftertaste caused by mold growth over long-term solar drying (45). Even today, with parboiled rice being dried in commercial driers (hence no musty taste), the parboiled rice remains out of favour because this processing causes a darkening of the endosperm, decreasing consumer acceptability (44).

As noted above, thiamin is required for carbohydrate metabolism, therefore high consumption of carbohydrates (such as polished white rice) increases thiamin requirements (14). A short-term trial in 12 healthy Austrians (*n*=6 women, 6 men) reported significantly lower plasma and urine thiamin concentrations when diets moved from 55% carbohydrate (control diet) to 65% (4 day exposure) and 75% carbohydrates (4 day exposure), while keeping other factors constant (i.e. thiamin intake, diet, exercise), indicating higher thiamin usage at increased carbohydrate intakes (47). Higher requirements have been reported in the field as well: a 1988 outbreak of beriberi among 140 people in The Gambia highlighted important links between manual labour, high consumption of carbohydrates, and thiamin deficiency (48). Beriberi prevalence was three times higher among men compared to women, and one third of those men affected were aged 20-29 y. The outbreak occurred during the 'hungry season' (the time between last season's food running out and the start of the current year's harvest), so researchers

attributed the disproportionate number of young men affected to a combination of a heavy workload with high consumption of imported, polished white rice (48). Cambodian women face similar circumstances: physical labour is required to maintain the homestead, and approximately 60% of dietary energy is thought to come from polished white rice (8).

1.2.6 Assessment of thiamin status

1.2.6.1 Blood

Erythrocyte transketolase activity coefficient (ETKac) is widely regarded as the best functional indicator of thiamin deficiency (17,18). TDP is a cofactor with transketolase in the pentose phosphate pathway (which takes place in erythrocytes), and therefore measuring the activity of transketolase before and after the addition of excess TDP reveals the original level of TDP saturation within the erythrocytes, indicating thiamin adequacy. If the cells had sufficient TDP, the ETKac would not change after the addition of excess TDP, and an ETKac ratio of 1 would be calculated. If the erythrocytes were originally deficient in thiamin, then the addition of excess TDP would increase ETKac, and the ETKac ratio would rise above 1 (17,18) (see **Figure 1-4**). ETKac >1.25 is commonly used as a cut-off for thiamin deficiency (18).

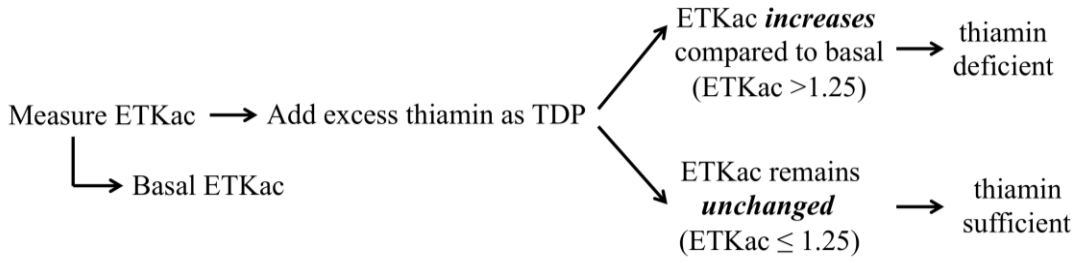


Figure 1-4: Principle of erythrocyte transketolase activity coefficient (ETKac) assay

Although ETKac is regarded as the best indicator of thiamin status because it provides a functional measure of thiamin, this test has several downfalls including poor inter-assay precision, and the rapid inactivation of transketolase during sample processing and storage (49). In addition, there have been reports of this assay underreporting activity coefficients among chronically deficient populations (1,19).

To address these shortcomings, an alternate method is now more commonly used to measure TDP directly: high performance liquid chromatography with a fluorescent detector (HPLC-FLD) (49,51). The vast majority (95%) of thiamin in blood is present as TDP (52), and it depletes at approximately the same rate as other tissues (18,53), making it an ideal candidate for measurement. TDP is stable in blood for at least 24 hr at room temperature, and for up to 7 months at -70°C (49). HPLC also yields high inter-assay precision, and can be easily standardized with commercially available TDP. TDP measurement with HPLC-FLD also correlates well with ETKac (49). However, direct assessment of blood thiamin makes interpreting results more difficult as compared to a functional measure because the TDP available for use remains unknown.

Indeed, interpretive criteria for sufficient thiamin status using erythrocyte TDP (eTDP) is still unclear as cut-offs vary widely (17). The Institute of Medicine defines thiamin deficiency as eTDP < 70 nM (18); however this guideline is based on values from one group of Dutch blood donors (*n*=98) in the 1980s (18,54). Interestingly, these cut-off values are described by the Institute of Medicine as 'erythrocyte thiamin' (18), but in the

original report are referred to as cut-offs for 'whole blood or red cells' (54). These terms should not be used interchangeably; if these cut-offs are based on whole blood analysis, the erythrocyte cut-offs should be ~40% higher (taking into account the hematocrit). Wilkinson and colleagues put forth a much higher cut-off for suboptimal thiamin in erythrocytes of <140 nM; this was calculated as a reference limit for the bottom 2.5% of healthy New Zealander blood donors (*n* unknown) (55). An even higher cut-off of <148 mM has been suggested as it is at the lower range of 'normal' among British adults (17,56). In practice, reference ranges of eTDP vary widely. A study among British adolescents aged 13-14 y (*n*=35 girls, 19 boys) reported eTDP (mean [range]) of 227 nM (101-950) and 206 nM (120-445) among girls and boys, respectively (56). Among a sample of healthy British laboratory staff (*n*=29 male, 16 female) aged 20-60 y, mean eTDP was 174 nM (52). In Cambodia, Coats *et al* reported whole blood TDP adjusted for hematocrit (eTDP equivalent) of 150 nM (95% CI: 134, 166; *n*=27) among a group of healthy lactating mothers (11). Unfortunately, to the best of my knowledge, there are no known reference ranges for healthy, thiamin-replete, non-pregnant, non-lactating Cambodian women of childbearing age.

1.2.6.2 Breast milk

Three thiamin vitamers are found in human milk: thiamin, TMP (which is present in highest concentrations), and TDP (57). For the last 60 years, thiamin concentrations in milk have been measured using the thiochrome method, wherein a derivatizing agent is used to alter the molecular structure of thiamin (2 rings, see **Figure 1-1**) to thiochrome (3 rings), which fluoresces (35). More recently, researchers have built upon this method by

embedding the thiochrome derivatization within online pre- or post-column HPLC-FLD, allowing for precise and highly repeatable measurements (35). The same advantages of TDP measurement in blood with HPLC-FLD apply to breast milk.

As noted in *1.2.3.2 Dietary thiamin requirements (infants)*, the AI for thiamin for infants aged 0-6 mo is 200 μg/d. It is important to note, however, that the AI is contentious as more recent reports of breast milk thiamin concentrations are lower than these estimates, likely due to improvements in analytical techniques for quantification of thiamin in biological samples during the past 35 years (35). For instance, a recent report of median (range) total thiamin concentrations in mature milk (≥2 weeks) from women worldwide highlighted wide variation in breast milk thiamin concentrations by region, with no group approaching 210 μg/L: Cameroon, 116 μg/L (86-221; *n*=5); China, 31 μg/L (15-127; *n*=5); India, 11 μg/L (4-75; *n*=24); Malawi, 21 μg/L (2-152; *n*=18); United States, 37 μg/L (5-66; *n*=28) (58). In addition, infant breast milk consumption changes with age (59). More research is required to better understand the usual thiamin content, measured using valid and reliable analytical techniques, of breast milk produced by healthy, thiamin-replete, and overall well-nourished mothers of infants aged 0-6 mo.

1.2.7 Thiamin deficiency and beriberi

1.2.7.1 Thiamin deficiency

Thiamin deficiency manifests with several different clinical presentations, in adults as wet, dry, and Shoshin beriberi, and Wernicke encephalopathy (Wernicke-Korsakoff

syndrome), and in infants as infantile beriberi (13). Clinical presentations of these different forms of thiamin deficiency can be found in **Table 1-2**.

Table 1-2: Clinical presentation of thiamin deficiency

	Clinical Presentation	References
Dry beriberi	• peripheral neuropathy with symmetric, bilateral impairment of motor functions in distal limbs, most notably legs • paresthesia of feet and toes, calf muscle tenderness • acute encephalopathy	(13,60,61)
Wet beriberi	• high cardiac output • tachycardia • cardiomegaly, right ventricular hypertrophy • vasodilation in the extremities • sweating, warm skin • renal water retention, leading to edema • heart failure	(13,60,62,63)
Shoshin beriberi	• same as wet beriberi, but with rapid onset	(13,60,61)
Wernicke-Korsakoff syndrome	• associated with chronic, excessive alcohol intake • ataxic gait • loss of ocular control (ophthalmoplegia, nystagmus) • confusion, memory impairment • peripheral neuropathy	(13,64,65)
Infantile beriberi	• presents among breastfed infants aged 2-4 mo • dysphonia (distinctive hoarse cry) • tachypnea and dyspnea, tachycardia • cardiomegaly, right ventricular hypertrophy • hepatomegaly • heart failure • anorexia, vomiting, oliguria • generalized edema • convulsions	(11,13,19,66,67)

As a vitamin deficiency disease beriberi is reversible, however if left untreated it has serious consequences (13,65,68): without treatment, Wernicke-Korsakoff syndrome

causes long-term, irreversible memory damage (65), and infants can die of infantile beriberi within hours of clinical presentation without rapid thiamin administration (68).

Interestingly, humans are much more sensitive to thiamin deficiency than animals: thiamin concentrations of human brains are much lower than other animals, potentially highlighting the sensitivity of thiamin deficiency in humans compared to other species, most notably rodents (22). In addition, unlike rodents, who have a large hepatic thiamin storage capacity, humans have limited storage of thiamin (22) with stores depleting on a thiamin-free diet within two weeks (31).

1.2.7.2 Historical context

Beriberi has a long history in the medical literature, with references found in Chinese medical texts as early as 2600 BC (45,68). However, it was not until the 1880s that beriberi underwent systematic investigation. Kanehiro Takaki, a surgeon in the Japanese navy, became interested in kakké (Japanese term for beriberi) after estimating that three quarters of the patients in the Tokyo Naval Hospital were suffering from this disease when he began his tenure in 1870 (45). Takaki studied medical records from all the Japanese naval ships, and identified that there was no pattern in kakké prevalence or mortality based on ship population density, routes, or weather. As such, he turned to diet, conducting controlled dietary experiments on naval vessels. Takaki postulated nitrogen/protein deficiency was the cause of kakké after noting the higher quality of British and German naval meals, so replaced some of the white rice with meat, condensed milk, bread, and vegetables on Japanese naval ships. Although his nitrogen hypothesis

was incorrect, the replacement of thiamin-poor white rice with thiamin-rich foods eradicated kakké mortality in the Japanese navy by 1887 (45). During the same time period, Christiaan Eijkman conducted a series of experiments with chickens in the Dutch East Indies (69). Eijkman showed that consumption of white rice caused beriberi among chickens, while brown rice consumption prevented the disease (69). It is worth noting, however, that beriberi was not confined to the Dutch East Indies (modern-day Indonesia) or Japan. As noted above, beriberi was long known as kakké in Japan, which is actually translated from the Chinese term for 'leg disease' (45); in Java, Dutch physician Jacobus Bonitus first described the disease as beriberi, which translates to 'sheep' in local language, in reference to patients' tottering, knee-shaking gait (45,60). As early as 1913, beriberi was treated with an extract derived from rice polishings in the Philippines (45).

Beyond beriberi, thiamin itself is also of historical note due to several 'firsts': thiamin was the first vitamin to be isolated and synthesized. Casimir Funk isolated the 'anti-beriberi' factor from rice bran in 1911 and dubbed it 'vitamine' (60), and in 1936 R. R. Williams identified the correct chemical structure of thiamin and successfully synthesized it in the lab (69).

1.2.8 Infantile beriberi in Southeast Asia: a disease of white rice consumption

After the discovery of thiamin and its role in the prevention and treatment of beriberi, this disease became relatively uncommon until an outbreak of infantile beriberi in refugee camps on the Thai-Burmese border in the 1980s (68,70). Between 1987 and 1990, 40% of the extremely high 18% infant mortality among Karen infants residing in these refugee

camps could be attributed to infantile beriberi, despite access to high quality antenatal care (68). This was surprising to healthcare practitioners as reports of beriberi among adults were rare. Researchers went on to show that women did not have a thiamin-rich diet, and were exposed to several thiamin antagonists: diets consisted of polished white rice and fermented fish paste, and betel nut chewing was extremely common (79% of women; 92% of whom chewed betel nuts within one hour of a meal) (68).

Mothers with low dietary thiamin intake and/or poor biochemical thiamin status produce breast milk low in thiamin, putting their infants at risk of developing thiamin deficiency and infantile beriberi (57). Infantile beriberi presents in breastfed infants aged two to four months consuming thiamin-poor breast milk from thiamin deficient mothers (13,57). With recommendations that breast milk be the sole source of nutrition for infants under 6 months (71), maternal dietary thiamin intake must be improved to prevent infantile beriberi and related mortality (45).

Infantile beriberi was addressed in the Karen refugee camps through perinatal maternal thiamin supplementation, as well as intramuscular thiamin administration to infants presenting with clinical symptoms (68,72). Similarly, supplementation of thiamin deficient lactating women has been shown to improve breast milk thiamin concentrations during research projects in rural Cambodia (73), the Gambia (74), and India (75).

While infantile beriberi was addressed in these refugee camps, it remains an often-overlooked cause of infant mortality throughout Southeast Asia, where well-polished,

non-parboiled rice remains the dietary staple (11,29,76–79). In 2008 there were 3,038 cases of infantile beriberi in the Kantha Bopha Hospitals in Phnom Penh and Siem Reap, Cambodia alone (*personal communication, Kantha Bopha Hospital*). A recent study among ethnic groups in northern Laos reported a high infant mortality rate of 50 deaths of infants aged 0 – 6 mo among 468 live births in the 22 villages included in the survey (77). Of these 50 infant deaths, 36 occurred when infants were aged 1-3 mo, and 17 were suspected to be caused by infantile beriberi (77). Similarly, thiamin deficiency appears to be prevalent throughout Laos, including in the capital city Vientiane where 13% biochemical thiamin deficiency (defined as basal ETKA < 0.59, without clinical signs of beriberi) was reported among a cohort 778 of sick infants <12 mo (78). The authors of that study referred to infantile beriberi as 'a forgotten disease in Asia' (78). Indeed, a major gap in the current literature is the lack of infantile beriberi prevalence data. Much of the current documentation of infantile beriberi comes from case reports, or focuses on specialized groups including refugee populations (11,66,68,70). Although anecdotal reports of infantile beriberi are common among rural Cambodian health care providers, the lack of representative prevalence data hinders our understanding of the magnitude of this public health issue.

As shown in **Table 1-2**, many of the signs of infantile beriberi that would be more obvious to mothers, such as vomiting, oliguria, anorexia, dyspnea, tachypnea and tachycardia (11,13,19,66,67), are general symptoms that may not seem of immediate risk to infants, and as such may not prompt a quick trip to the health centre. Since death can

occur within hours of clinical presentation (68), it is possible that infantile beriberi-related mortality goes improperly diagnosed.

1.2.9 Interventions to combat infantile beriberi

Thiamin-rich foods are not typically consumed in Cambodia due to cost (i.e. expensive animal-source foods including pork, organ meats), or availability and cultural norms (i.e. legumes, soy). In addition, an estimated 60% of daily calories come from non-parboiled (44), polished white rice (8), which is a poor source of thiamin (13). A recent report used Food Balance Sheet data to highlight probable micronutrient deficiencies across the Western Pacific Region (80). Of the 17 countries surveyed, Cambodia had the lowest estimated amounts of thiamin per capita in the available food supply. Dietary thiamin intake was estimated at 0.6 mg, well below the RDA of 1.4 mg/day for pregnant and lactating women (18,80). As such, changing dietary behaviours to increase thiamin intake is a long-term, multi-sectorial challenge. With evidence of infantile beriberi cases in Southeast Asia, a timely intervention to increase thiamin intake of Cambodian women is warranted to combat this disease.

Thiamin supplementation is an obvious solution, as supplementation among thiamin deficient lactating women has been shown to improve breast milk thiamin concentrations (68,72–75). Supplementation is advantageous as it provides the correct dose only to those who require thiamin (deficient individuals; pregnant and lactating women). In addition, perinatal micronutrient supplements are already recommended: Cambodian Ministry of Health guidelines indicate iron-folic acid supplements (IFA) as standard of care

throughout pregnancy (90 tablets distributed over two antenatal care appointments) and post-partum (42 tablets provided at first postpartum contact) (81). Adding thiamin to IFA could be one means of improving perinatal thiamin intake. However supplementation is a targeted, costly, and resource-intensive intervention that relies heavily on individual compliance. A recent assessment of IFA in two Cambodian provinces showed that only 47% of women were adherent (82). While thiamin could be incorporated into IFA, uptake would likely be similarly low due to known adverse side effects, namely gastrointestinal discomfort, from iron.

Food fortification, or adding vitamins and minerals to commonly consumed foods, is another option for improving thiamin status. Food fortification has been successfully employed in Canada since the mid-twentieth century; in conjunction with a diverse diet, salt iodization, the addition of vitamins A and D to milk, and B vitamin enrichment of white flour have nearly eradicated micronutrient deficiency diseases (36). In Cambodia, fortification is gaining popularity: salt iodization is mandatory (83), and iron (fish and soy sauce) and vitamin A (vegetable oil) fortification programs are being piloted (84–86). Fortification has several advantages: it is a sustainable, cost-effective, and passive intervention that requires no behaviour change (87–90). As a population-wide intervention, there is potential to reach large sections of the population with relatively low cost and effort (91). All consumers would receive thiamin, which is beneficial in Southeast Asia where thiamin consumption is known to be low (13,29,45).

However, fortification does have several downfalls, including a lack of consumer choice, risk of over-consumption of the nutrient, and potential for interaction with other nutrients (87). While overall considered an inexpensive intervention, there are related costs including start-up infrastructure and equipment maintenance, as well as a need for quality assurance programs both at the factory and through the government (for mandatory fortification) (87). Finally, fortification can not reach everyone; due to unequal household food distribution, the highest consumers of fortified products in Cambodia would likely be adult men, rather than those most in need, pregnant and lactating women, and the cost of a fortified product may be inhibitive to those most in need (low socioeconomic status, most food insecure).

While these downfalls should be addressed, in the case of thiamin in Cambodia, a large proportion of the population would likely benefit from increased thiamin intake since marginal thiamin deficiency is known to cause apathy, fatigue, loss of appetite, and dizziness (45), and may be common among other at-risk groups such as the elderly (22) and those with high carbohydrate intakes (14,47). There is a low risk of adverse effects from high thiamin consumption (18), so fortification has the potential to be a passive and sustainable intervention to improve dietary thiamin intake in rural Cambodia.

Rice is an obvious staple to fortify with thiamin as recent food balance sheet analysis estimate it makes up approximately 60% of dietary energy (8). Indeed, the Khmer translation of ‘eat’ is ‘eat rice’. However, thiamin fortification of rice would be challenging and costly. Previous attempts to fortify rice with thiamin in Southeast Asia

were unsuccessful as rice is typically washed three times before consumption, removing all of the powdered or spray-coated B vitamins (45). In addition, there are rice millers in nearly every Cambodian village, therefore fortification would need to take place locally, increasing costs and impacting quality control. Fish sauce, however, is a popular traditional Cambodian condiment consumed by 90% of the population (85), and since this condiment is already a fortification vehicle for iron (84–86), fortification infrastructure is already present in Cambodian factories (92). In addition, 44 fish sauce factories reach 78% of the Cambodian population (92). While a segment of the population makes their own fish sauce at home, fish sauce fortification has potential to improve the thiamin intake of a wide group of Cambodians.

1.3 Summary of rationale

Thiamin deficiency and infantile beriberi remain an often overlooked public health issue in Cambodia and the wider region (11,77–79,93,94). Improving maternal thiamin intake can prevent infantile beriberi among breastfed infants (13,57). An estimated 90% of Cambodians consume fish sauce (85), and this condiment is already a fortification vehicle for iron (84–86) so fish sauce fortification infrastructure is already present (92). As such, thiamin fortification of fish sauce could be an ideal means of improving the dietary thiamin intake of pregnant and lactating women and, in turn, their breastfed infants, for the prevention of infantile beriberi. The objectives of my doctoral research were to: 1) confirm that rural Cambodian women of childbearing age did indeed have low biochemical thiamin status; 2) formulate shelf-stable thiamin-fortified fish sauce that would be acceptable to rural Cambodia women; and 3) determine the efficacy of this

thiamin-fortified fish sauce to increase the biochemical thiamin status of rural Cambodian women of childbearing age and their children, compared to a control fish sauce containing no thiamin. These objectives, and my hypotheses are outlined in detail, below.

1.4 Research objectives and hypotheses

Infantile beriberi remains an often-overlooked cause of infant mortality in Cambodia (29,45,78); as such, the aim of this research program was to increase the dietary thiamin intake of Cambodian women with the overall goal of preventing infantile beriberi. Using an iterative approach, I examined the biochemical thiamin status of women of childbearing age, and then explored thiamin fortification of fish sauce as a means of increasing dietary thiamin intake to improve biochemical thiamin status in women and their children.

1.4.1 Objectives

1. To determine the biochemical thiamin status, as determined by eTDP, of representative samples of women of childbearing age (20-45 y) from rural and urban Cambodia, as compared to a convenience sample of purportedly thiamin-replete Canadian women.

2. If women did have poor biochemical thiamin status, to develop a fortified fish sauce in which:
   a) thiamin degradation was minimal, and
   b) organoleptic properties were acceptable to rural Cambodian consumers.

3. To determine whether *ad libitum* consumption of the developed thiamin-fortified fish sauce at two concentrations (2 and 8 g/L) over six months could improve eTDP (and lactating women's breast milk) compared to a control sauce containing no thiamin, among two groups of women (18-45 y) in rural Cambodia:
   a) non-pregnant, non-lactating women and their youngest children aged 12-59 mo (non-pregnant cohort), and
   b) pregnant and lactating mothers and their newborn breastfed infants (pregnant and lactating cohort).

1.4.2 Hypotheses

1. Null hypothesis (H_0): eTDP concentrations do not differ between women of childbearing age living in rural Cambodia, urban Cambodia, and Canada.

   Research hypothesis (H_A): Purportedly thiamin-replete Canadian women will have higher eTDP concentrations than Cambodian women, and Cambodian women living in an urban centre will have higher eTDP than rural women.

2. a) Null hypothesis (H_0): Thiamin will be stable in a fish sauce matrix.

   Research hypothesis (H_A): Thiamin will not be stable in a fish sauce matrix.

2. b) Null hypothesis (H_0): The addition of thiamin to fish sauce will not cause any organoleptic changes that affect consumer acceptance of thiamin-fortified fish sauce.

Research hypothesis (H_A): The addition of thiamin to fish sauce will cause organoleptic changes that affect consumer acceptance of thiamin-fortified fish sauce.

3. a) Null hypothesis (H_0): Women and their children consuming thiamin-fortified fish sauce over six months will have the same eTDP as those consuming a control fish sauce containing no thiamin; there will be no dose response in eTDP corresponding to different fortified fish sauces (2 g/L and 8 g/L).

Research hypothesis (H_A): Six month consumption of fish sauce fortified with thiamin will increase maternal and child eTDP in a dose-dependent manner (8 g/L > 2 g/L > control).

3. b) Null hypothesis (H_0): Women consuming thiamin-fortified fish sauce over six months, and their breastfed infants will have the same eTDP (and breast milk thiamin concentrations) as those consuming a control fish sauce containing no thiamin; there will be no dose response in eTDP corresponding to different fortified fish sauces (2 g/L and 8 g/L).

Research hypothesis (H_A): Six month consumption of fish sauce fortified with thiamin will increase maternal and child eTDP and breast milk thiamin concentrations in a dose-dependent manner (8 g/L > 2 g/L > control).

Chapter 2: Poor thiamin status is common among women of childbearing age in rural and urban Cambodia

2.1 Summary

Background: Thiamin deficiency in infancy is the underlying cause of beriberi, which can be fatal without rapid treatment. Reports of infantile beriberi are not uncommon in Cambodia, however population representative data are unavailable.

Objective: To determine the biochemical thiamin status among women of childbearing age in rural and urban Cambodia.

Methods: We measured erythrocyte thiamin diphosphate (eTDP), an indicator of thiamin status, in a representative sample of Cambodian women (20-45 y) in urban Phnom Penh (n=117) and rural Prey Veng (n=121), Cambodia, and for comparison purposes, in a convenience sample of women in urban Vancouver, Canada (n=47).

Results: Mean ± SD eTDP was significantly lower among women in Prey Veng (149 ± 36 nM) than Phnom Penh (156 ± 32 nM), which, in turn, was lower than in Vancouver, (179 ± 37 nM; P<0.05).

Conclusions: Cambodian women have significantly lower eTDP values than purportedly thiamin-replete women from Vancouver, Canada. Strategies may be needed to improve thiamin status among women in Cambodia.

2.2 Introduction

Beriberi, a disease caused by severe thiamin deficiency, is rare in economically developed regions but is thought to be more common in countries where dietary sources of thiamin are low, particularly those in Southeast Asia (11,68,78,95). Infantile beriberi is

characterized by a persistent hoarse cry, vomiting, anorexia, generalized edema, oliguria (96), convulsions, and heart failure (11), and is often fatal without rapid thiamin administration (67,78). Beriberi is most serious and life-threatening in infants due to the rapid growth and development that occurs during the first months of life (13). Beriberi typically presents in exclusively breastfed infants whose mothers have suboptimal thiamin status and consequently have low breast milk thiamin concentrations (57). Interestingly, it is not uncommon for infants to present with beriberi while their mothers remain asymptomatic (11,13,67). In Cambodia, low dietary thiamin intake is likely a result of multiple factors: the high consumption of polished white rice, which has been removed from the B-vitamin-containing husk (8,46), a lack of parboiling rice (97), and low dietary diversity (1). In a recent study, Coats *et al*. (11) found evidence of thiamin deficiency among mother-infant pairs in rural Cambodia based on levels of whole blood thiamin diphosphate concentrations (TDP), an indicator of thiamin status.

Although there has been some documented evidence of thiamin deficiency in Cambodia, there is a lack of population representative data from both urban and rural areas. The prevalence of thiamin deficiency among Canadian women of childbearing age is thought to be extremely low due to the mandatory fortification of grain products (18,36,87) and access to a diverse diet including thiamin-rich animal source foods. There is little data highlighting the erythrocyte thiamin diphosphate concentrations (eTDP) of healthy, B vitamin-replete women of childbearing age to which we could compare the Cambodian values; therefore, we recruited a small convenience sample of healthy women in Vancouver, Canada.

We aimed to measure eTDP, an indicator of thiamin status, among women of childbearing age in rural and urban Cambodia, and for comparison purposes, urban Vancouver, Canada.

2.3 Methods

2.3.1 Participants

In this observational, cross-sectional study, representative samples of women of childbearing age (20-45 y) were recruited in urban Phnom Penh (*n*=160) and rural Prey Veng (*n*=160), Cambodia. For comparison purposes, a convenience sample of purportedly B vitamin-replete women of childbearing age (20-45 y) was also recruited in urban Vancouver, British Columbia, Canada (*n*=51). Women who were pregnant, lactating, or taking B vitamin-containing supplements were excluded. Ethics approval was obtained from the University of British Columbia Clinical Research Ethics Board (H12-02847 and H13-01319) in Canada and the National Ethics Committee for Health Research (0004NECHR) in Cambodia. Written informed consent was obtained from all women.

2.3.2 Sampling design

A list of all villages in Prey Veng and Phnom Penh provinces was obtained from the Cambodian Ministry of Planning. Using a computer-generated random number list, simple random sampling was employed to select 16 villages from each region. In each of the 32 villages the Village Chief used the Village Registry to compose a list of all eligible

women, from which 10 women per village were selected using a random draw and invited to participate. If a selected woman was unable or unwilling to participate, an additional woman was randomly selected until 10 women per village were successfully recruited.

In Vancouver, British Columbia, Canada, a convenience sample of women of childbearing age (20-45 y) was recruited from The University of British Columbia by posters, emails, and word of mouth. Eligibility for study participation was confirmed via email or over the telephone. The first 51 eligible women who contacted the study team were recruited to participate.

2.3.3 Data and blood collection

In Cambodia, data and blood collection took place from January 29 to February 7, 2013. Trained enumerators administered a short demographic questionnaire in the woman's home, and height and weight were measured (see questionnaire in Appendix A). The next morning, a non-fasting venous blood sample was collected from each woman at her local health centre into an evacuated tube containing EDTA (Becton Dickinson Vaccutainer, Mississauga, ON). Response rates for blood collection were 91% in Phnom Penh (n=146 of 160) and 98% (n=156 of 160) in Prey Veng. Blood was transported on ice to the National Institute of Public Health (NIPH) in Phnom Penh daily for processing and storage. Blood samples were spun in a refrigerated (4°C) centrifuge, plasma and buffy coat were removed, erythrocytes were washed three times with phosphate buffered saline

(Amresco, Solon, OH), aliquoted, and stored at -80°C. All samples were shipped on dry ice to the University of British Columbia, Canada.

In Vancouver, data and blood collection took place from July 4 to July 15, 2013. Women completed a short demographic questionnaire under the supervision of a research assistant. All other procedures were identical to those in Cambodia. All blood samples were immediately processed and stored at -80°C, and batch analyzed with the Cambodian samples.

2.3.4 Laboratory analysis

TDP was measured in erythrocytes because the majority (~90-95%) of thiamin in blood is present as TDP (49,52), and it declines in erythrocytes at approximately the same rate as other tissues (18,53). eTDP was measured at UBC using reverse-phase high performance liquid chromatography with a fluorescence detector (HPLC-FLD) according to Lu & Frank (51), with modifications. Briefly, 500 µL of 10% wt/vol trichloroacetic acid in deionized water was added to a mixture of 250 µL previously frozen packed erythrocytes and 250 µL deionized water. Samples were vigorously vortex mixed, placed on ice for 15 min, and then centifuged (13000 *g*, 10 min). An aliquot of supernatant (500 µL) was washed twice with 750 µL of water saturated methyl-tert-butyl ether. From the aqueous layer, a 150 µL aliquot was then transferred to a 96 well plate. HPLC analysis was performed using an Agilent 1260 Infinity system with a Poroshell 120 EC-C18 column (3.0 x 50 mm with 2.7 µm; Agilent Technologies, Mississauga, ON) at 25°C with the detector set at an excitation wavelength 375 nm and emission wavelength 435 nm.

Mobile phase A consisted of 25 nM sodium phosphate (pH 7.0) and methanol (90:10 vol/vol), while mobile phase B consisted of 25 nM sodium phosphate (pH 7.0) and methanol (30:70 vol/vol). Prior to injection, online sample derivatization (methanol, sample, and 1.2 mmol/L potassium ferricyanide in 15% wt/vol sodium hydroxide) was performed by automated injector programming. Quantitation of eTDP was based on peak area and external standardization using TDP calibration solutions (~20-800 nM thiamin pyrophosphate ≥ 95%, Sigma-Aldrich, Oakville, ON).

2.3.5 Data analyses

Data for eTDP are expressed as means ± SD. Differences in women's characteristics and eTDP were determined using one-way ANOVA and Tukey's test with three groups (Phnom Penh, Prey Veng, Vancouver) or an independent samples t-test (Cambodia and Canada). Results were considered significant at $P<0.05$. All analyses were performed using SPSS for Macintosh version 22.0 (IBM Corp., Armonk, NY).

2.4 Results

All Cambodian Village Chiefs we approached agreed to participate, and of the women recruited to participate, only one woman refused (361 women were invited to participate). Blood samples available for analysis were as follows: Phnom Penh, $n=117$; Prey Veng, $n=121$; Vancouver, $n=47$. A comparison of demographic characteristics and eTDP is outlined in **Table 2-1**. In this study, women were significantly older in Cambodia compared to women in Vancouver ($P<0.001$), likely due to the different sampling methods used in Canada and Cambodia. Approximately two thirds of Vancouver women

were of European descent, and one third were Chinese; all Cambodian participants were Khmer. The majority of participants had a body mass index (BMI) within the normal range. eTDP was significantly different among women living in different regions: Prey Veng, 149 ± 36 nM, Phnom Penh 156 ± 32 nM, and Vancouver, 179 ± 37 nM (P<0.05).

Table 2-1: Characteristics and eTDP of women aged 20-45 y in Cambodia and Canada[1,2]

	Phnom Penh, urban Cambodia	**Prey Veng, rural Cambodia**	**Vancouver, urban Canada**
	n=117	*n*=121	*n*=47
Age, *y*	33 ± 7[a]	36 ± 6[b]	26 ± 5[c]
Body Mass Index, *kg/m²*	23.1 ± 4.0[a]	21.7 ± 2.9[b]	22.0 ± 2.0[ab]
Underweight (≤ 18.5)	13 (11)	15 (12)	1 (2)
Normal (18.51 – 24.99)	69 (59)	92 (76)	42 (89)
Overweight (25 – 29.99)	28 (24)	12 (10)	4 (9)
Obese (≥ 30)	7 (6)	2 (2)	0 (0)
Ethnicity			
Khmer	117 (100)	121 (100)	0 (0)
European	0 (0)	0 (0)	32 (68)
Chinese	0 (0)	0 (0)	15 (32)
Live Births[3], *number*	2.4 ± 1.3[a]	2.9 ± 1.5[a]	1.7 ± 0.58[a]
Education			
None	5 (4)	11 (9)	0 (0)
Primary (years 1-6)	66 (56)	88 (73)	0 (0)
Secondary (years 7-12)	43 (37)	22 (18)	0 (0)
Higher education	3 (3)	0 (0)	47 (100)
Number in Household	5.6 ± 2.5[a]	4.8 ± 1.6[b]	2.6 ± 1.2[c]
Annual Household Income[4,5], *$US*	2,943 ± 2,327[a]	1,482 ± 1,469[a]	65,251 ± 49,878[b]
Bottom 20%	59 (50)	93 (78)	3 (7)
Middle 60%	42 (36)	22 (18)	35 (83)
Top 20%	16 (14)	5 (4)	4 (10)
eTDP, *nM*	156 ± 32[a]	149 ± 36[b]	179 ± 37[c]

[1] Values are mean ± SD or number (%)
[2] For continuous variables, means in a row without a common letter indicate a significant difference (P<0.05; Tukey post-hoc test)
[3] Of women who have ever given birth: Phnom Penh, *n*=100; Prey Veng, *n*=107; Vancouver, *n*=3
[4] Prey Veng, *n*=120; Vancouver, *n*=42
[5] Participants classified using wealth quintiles (2011) for Canada (98) and Cambodia (99)

2.5 Discussion

Thiamin deficiency has been described in Southeast Asia for many years, historically in Myanmar (68,70), Laos (67,78), Thailand (95), and more recently in Cambodia (11,73), but many of the studies were case reports, or focused on refugee populations, or individuals with clinical disease. In Prey Veng, Coats *et al*. (11) compared the whole blood TDP concentrations of mother-infant pairs of Cambodian infants with clinical symptoms of beriberi (*n*=27 pairs), without beriberi (*n*=27 pairs), and an American reference group (*n*=20 pairs). In their study, low whole blood TDP was prevalent among all Cambodian infants and mothers, regardless of the beriberi status of the infant. However, that study was limited to one district within Prey Veng, and recruited a convenience sample of mother-infant pairs seeking medical treatment at one health centre (11). Similarly, no women in the current study presented with symptoms of beriberi, so we echo Coats and colleagues' call for more research to better understand the relationship between blood thiamin concentrations and the presentation of clinical disease.

Our study has a number of strengths. Most notably it used a population-representative sample of women in urban (Phnom Penh) and rural (Prey Veng) Cambodia with a very high response rate. However, we acknowledge a number of limitations. First, our sample of Vancouver women was a convenience sample of younger women recruited from a university campus, and therefore does not reflect the thiamin status of women of childbearing age in Canada. Second, we used simple random sampling instead of probability proportional to size sampling (PPS) to select the villages. PPS takes into consideration the size of the village and thus the potential importance of larger sampling

units. Fortunately villages in the sampling regions were roughly the same size, and there is little reason to believe thiamin intake differs dramatically between villages within the same region.

We did not collect information on women's dietary intake in this study, so while we presume the lower eTDP among Cambodian women was caused by a lower dietary intake of these vitamins, this cannot be confirmed. However, a recent analysis of Food Balance Sheets was used to predict likely micronutrient deficiencies throughout the Western Pacific Region, and reported that thiamin is likely lacking in the Cambodian diet (80). Of the 17 countries investigated, Cambodia had both the lowest estimated daily per capita amount of thiamin (0.58 mg/d) and the lowest estimated daily per capita thiamin density per 1,000 kcal in the available food supply (0.29 mg) (80).

In this study we chose not to include pregnant and lactating women. Dietary thiamin requirements are higher in pregnant and lactating women (18,31), so while we did not include this group of women we presume that this group would also have lower eTDP than the Canadian women surveyed. The investigation of thiamin status among pregnant and lactating women in Cambodia has important public health implications for the prevention of infantile beriberi and warrants further investigation.

We acknowledge that at present there is a lack of established standard cut-offs for thiamin deficiency. The Institute of Medicine thiamin cut-offs are controversial as they are based on values from a small group of Dutch blood donors (n=98) in the 1980s

(18,100). Interestingly, these cut-off values are described in the Institute of Medicine guidelines as 'erythrocyte thiamin' (18), but in the original citation are referred to as cut-offs for 'whole blood or red cells' (100). These terms should not be used interchangeably; if these cut-offs are based on whole blood analysis, the erythrocyte cut-offs should be ~40% higher (taking into account the hematocrit). With this, we did not employ cut-offs in this study. It was also for this reason that we recruited Vancouver women to act as a reference group. The Institute of Medicine values as well as other published eTDP reference ranges came from relatively small sample sizes (for example, British laboratory staff, n=29 men, 16 women) (52), a convenience sample of male and female blood donors of unknown sample size (55), or adolescent boys (n=19) and girls (n=35) (56), and all were published in the mid-1990s before the current HPLC method was employed (51), making comparisons difficult. However, while the Vancouver group who formed the reference group were all women of childbearing age, there are also limitations: the Vancouver women were recruited using convenience sampling, and no dietary data was collected so may not all have actually had adequate thiamin intake. Future research should focus on the development of clinically meaningful cut-offs for thiamin deficiency.

2.6 Implications and conclusions

We found lower eTDP among women of childbearing age in rural and urban Cambodia compared to women in Vancouver, Canada. Given the absence of infantile beriberi in Canada, strategies such as supplementation, fortification, and/or food-based interventions may be warranted to improve the thiamin status of Cambodian women.

Chapter 3: Thiamin-iron fortified fish sauce: stability and sensory perceptions in rural Cambodia

3.1 Summary

Background: Infantile beriberi remains a cause of infant mortality in Cambodia as low maternal thiamin (vitamin B_1) consumption results in production of thiamin-poor breast milk. We formulated two thiamin-fortified fish sauces, low concentration (LC; 2 g thiamin hydrochloride (THCl)/L fish sauce) and high concentration (HC; 8 g/L) as a means of increasing maternal thiamin intake with potential to prevent infantile beriberi.

Objective: To test the stability of thiamin in fish sauce after exposure to light, oxygen, and heat in the laboratory, and under typical storage and use conditions in rural Cambodian households. In addition, we aimed to test consumer acceptability of newly formulated fish sauces through sensory evaluation, as compared to a control sauce containing no thiamin.

Methods: Thiamin-fortified fish sauce was exposed to light, oxygen, and light + oxygen for up to 21 days, and exposed to heat at 100°C for up to 35 minutes. Sensory evaluation was conducted among 90 women aged 18-45 y in Prey Veng, Cambodia using the Triangle Test, Paired Preference Test, and a Nine Point Hedonic Scale.

Results: THCl was shelf stable in fish sauce. Mean ± SD of THCl in household samples was 2.3 ± 0.4 and 9.7 ± 1.0 g/L for LC and HC fish sauces, respectively. Light, oxygen, light + oxygen, and heat exposure did not cause more than 10% degradation in most samples. Women enjoyed the taste of the newly formulated fish sauces, and only approximately one third of women could correctly identify the different sample in the Triangle Test, indicating that women were unable to differentiate fortified and control

fish sauces.

Conclusions: Thiamin is stable in a fish sauce matrix, and thiamin-fortified fish sauce is acceptable to rural Cambodian consumers.

3.2 Introduction

Thiamin is an essential vitamin involved in glucose metabolism and neuronal transmission (13). Thiamin deficiency is rare in western countries where thiamin-rich foods are consumed from a variety of sources, and some foods may be fortified (13,36,64,101). Unfortunately thiamin deficiency is still common in Southeast Asia, in part due to a heavy reliance on non-parboiled (44,45), thiamin-poor, polished white rice (11,68,78,95,97). We recently reported significantly lower blood thiamin concentrations among a representative sample of women of childbearing age in rural Prey Veng province, Cambodia, compared to a similar group of purportedly vitamin-replete Canadian women (93,94). Thiamin deficiency presents as infantile beriberi among breastfed infants aged two to four months consuming thiamin-poor breast milk from thiamin deficient mothers (13,57). Since breast milk is recommended as the sole source of nutrition for infants under 6 months (71), maternal dietary thiamin intake must be improved to increase breast milk thiamin, and prevent infantile beriberi and related mortality (45).

Major dietary sources of thiamin include whole grains including brown rice and rice bran, legumes, and pork (13), foods that are either not commonly consumed or are costly in Cambodia. Fortification is an ideal means of increasing population-wide dietary thiamin

intake because it is a sustainable, low cost, and passive intervention that requires no behaviour change (87–89). Fish sauce is consumed by an estimated 90% of Cambodians (85), and has been used as a fortification vehicle for iron in Vietnam (102,103) and Cambodia (84–86). Fortification of fish sauce with iron and thiamin is a potential means of addressing both micronutrient deficiencies using pre-existing factory infrastructure.

Thiamin degrades when exposed to neutral and alkaline pH, oxygen, heat (38,104,105), and although there is still some debate, light (13,31,38,105,106). Although fish sauce is acidic (107), typical Cambodian storage and use conditions impose risk of thiamin degradation through exposure to oxygen, light, and heat (cooking), potentially reducing efficacy of this product. In addition to stability, consumer acceptability of thiamin-fortified fish sauce is essential for uptake of this intervention. Two thiamin degradation products, 2-methyl-3-furanthiol (MFT) and bis(2-methyl-3-furyl) disulfide (MFT-MFT) are produced when thiamin degrades at high temperatures, producing a meaty aroma and flavour (108,109). Although typically associated with cooked meats, such as a recent report of thiamin degradation to MTF and MTF-MTF in hams cooked at 69°C for 120 min (109), they have been shown to appear at even lower temperatures, for example, in aqueous solution after storage for 7 days at 35°C (108), an ambient temperature which is not atypical in Cambodia. Therefore the objective of this study was twofold: first, to determine the stability of thiamin within a fish sauce matrix after exposure to common degraders (light, oxygen, heat) in a laboratory setting (mimicking household storage), and during real life, household storage conditions in rural Cambodia; and secondly, to

determine consumer acceptability through sensory evaluation of thiamin-fortified fish sauce.

3.3 Methods

In collaboration with Leang Leng Enterprises (Phnom Penh, Cambodia), we formulated three fish sauces for this study, two thiamin-fortified and one control (no detectable thiamin); all three fish sauces contained iron as per Cambodian government guidelines (86). These fish sauces were later employed in a randomized controlled efficacy trial in Prey Veng, Cambodia to determine the effect of consumption on biochemical thiamin status.

3.3.1 Fish sauce formulation and production

The World Health Organization recommends using the EAR cut-point method to determine optimal fortificant doses (87). This approach requires the target population's usual intakes of both the fortification vehicle and the micronutrient of interest (87). Using both usual intakes, the optimal dose is calculated so that only approximately 2.5% of the target population consumes less than the EAR, while only 2.5% consume quantities of the micronutrient above the UL (87). Note that thiamin does not have a UL as no adverse events have been reported from excess thiamin intake (18). Following this approach for thiamin-fortified fish sauce, the thiamin content of fish sauce should ideally increase thiamin consumption among the target population, pregnant and lactating women, to shift usual intake of thiamin upwards. If, for example, we assumed 100% thiamin deficiency among pregnant and lactating women, and assumed no thiamin sources in the diet, daily

consumption of 10 mL of fish sauce fortified at 0.14 g/L would provide 1.4 mg/d. See **Figure 3-1** for a hypothetical example of a usual intake distribution highlighting the thiamin EAR and RDA for pregnant and lactating women (18). Unfortunately, there are no published dietary intake data reporting thiamin or fish sauce intakes of Cambodian women. However, recent food balance sheet data indicates that only 0.58 mg/d thiamin is available per capita in Cambodia (80), an amount well below the EAR for pregnant and lactating women of 1.1 mg/d (18). Regarding fish sauce intake, a study evaluating iron-fortified fish sauce in Kampot province, Cambodia, required school children consume 10 mL fish sauce daily for 5 months as part of a school meal program (84). The authors of this study did not describe how this value was obtained, but did acknowledge that usual fish sauce consumption may be much lower than 10 mL/d, even among adults (84).

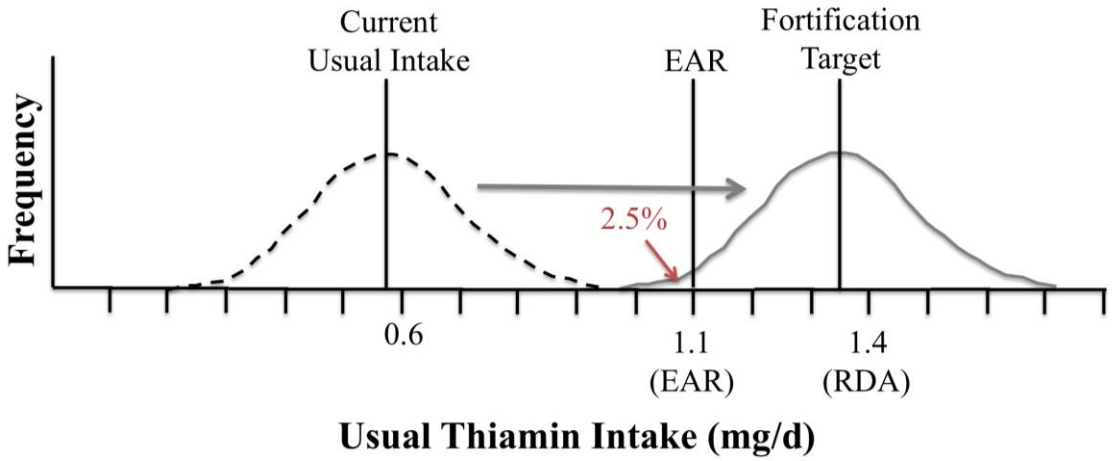


Figure 3-1: Schematic of hypothetical intake distributions using the EAR cut-point approach for thiamin fortification. Black dashed line: potential current thiamin intake distribution from food balance sheet estimates (80); grey line: resulting upward shift in usual thiamin intake distribution after introduction of thiamin-fortified fish sauce so that only 2.5% of target population consumes less than the EAR (18).

With limited data and no distribution ranges for usual intake, we were unable to employ the EAR cut-point method. Instead, because this fortified fish sauce was intended a

proof-of-concept study, relatively high concentrations of 2 and 8 g/L thiamin in fish sauce were formulated in order to identify an effect, if present. Further, as highlighted in *1.2.3.1,* the EAR for thiamin was based on a very weak evidence base. Since the fish sauce would be employed for a short-term (6 mo) intervention with regular fortnightly check-ins, and since there have not been reports of adverse events from excess thiamin intake, even with over-the-counter supplements containing 50 mg and more (18), we were not as concerned about harm from excess intake over 6 mo.

Fish sauce was fortified with thiamin as thiamin hydrochloride (THCl; ≥ 98% purity; Huazhong Pharmaceutical Co., Ltd, China) and iron as ferric sodium ethylenediaminetetraacetate (NaFeEDTA; Ferrazone®, Akzo Nobel Functional Chemicals B.V., The Netherlands). Three fish sauces with differing thiamin concentrations were formulated and bottled (one day, one 2300 L batch per formulation): low concentration thiamin (LC, 2 g/L THCl), high concentration thiamin (HC, 8 g/L THCl), and control fish sauce (no detectable thiamin).

Fish sauce was pasteurized at 100°C for 90-120 min then cooled to room temperature. Fortificants were added and stirred with a mechanical mixer for 30 min before bottling in identical 750 mL transparent plastic bottles. A 10% overage of THCl was added to LC and HC fish sauces to counter potential manufacturing losses. Fish sauce samples (5 mL) were collected every 15 min from the bottling line (~2 h; n=10, 10, and 7 for LC, HC, and control, respectively) to verify fortification. All fish sauce was fortified with 2.8 g/L NaFeEDTA according to Cambodian government guidelines (86), and received

Cambodian Ministry Health Certificates for Hygienic Food Production. Within 48 h of production, fish sauce was transported from the Leang Leng Factory in Phnom Penh to the Svay Antor District of Agriculture Office (~100 km east) for storage in a dark, dry room at ambient temperature (~25-28°C) until distribution to households (for household stability experiment). Several bottles of fish sauce were transported to Vancouver, Canada for controlled exposure experiments; there, fish sauce was stored in a dark, dry cupboard at ambient temperature (~20°C).

3.3.2 Thiamin stability

3.3.2.1 Laboratory exposure experiments

Thiamin stability in LC and HC fish sauces was assessed after exposure to light, oxygen, light + oxygen, and heat (100°C) under laboratory conditions mimicking household storage. Duplicate samples of LC and HC fish sauces (5 mL in capped 10 mL transparent plastic centrifuge tubes; Eppendorf, Mississauga, ON) were UV-exposed on a southeast-facing windowsill (clear glass) in Vancouver, Canada (approximately 15 h sunlight daily in July 2015) at room temperature (~20°C). Identical uncapped (oxygen exposed) fish sauce sample duplicates were stored in a dark cupboard at room temperature (~20°C). A third experiment exposed duplicate samples to both oxygen and light: uncapped samples were placed on the same southeast-facing windowsill. For all three experiments, samples were exposed for 0 h, 8 h, 24 h, and 2, 4, 7, 10, 14, and 21 d, and then stored at -80°C until batch THCl analysis. Exposure times were based on self-reported time to finish one-750 mL fish sauce bottle in households with 3 to 6 people in Prey Veng, Cambodia (mean ± SD days to finish one bottle = 14 ± 7 d, n=107 families). For oxygen and light +

oxygen exposure experiments, samples were weighed before exposure; samples were returned to their original volume with deionized water to control for volume loss due to evaporation.

Fish sauce was also exposed to heat to simulate cooking at 100°C (i.e. soup). Aliquots of 5 mL fish sauce in glass tubes were placed in a 100°C heating block (Analog Dry Block Heater, VWR International, Mississauga, ON) for 1, 3, 5, 7, 10, 15, 20, 25, 30, and 35 min. Samples were removed from heat after the allotted time, cooled to room temperature, brought back to their original volume with deionized water, and then stored at -80°C. Heat exposure duration was based on self-reported cooking time for Khmer soup for mean ± SD of 22 ± 14 min (*n*=83 women); note, however, that many women add fish sauce as final ingredient immediately before consumption.

3.3.2.2 Household shelf-stability

Fish sauce samples (0.5 mL) were collected from randomly selected households every two weeks between October 20, 2014 and April 6, 2015 (*n*=160) to determine thiamin stability under actual household storage and use conditions (storage temperatures ~26-28°C). Fish sauce samples were collected from the fish sauce bottle currently in use during regularly scheduled fortnightly home visits. Sealed samples were stored in a dark container and transported to the National Institute of Public Health in Phnom Penh within three days of collection for long term storage at -80°C. Samples were batch shipped on dry ice to Vancouver, Canada for THCl analysis.

3.3.3 Thiamin hydrochloride analysis

Fish sauce samples were mixed vigorously and diluted (LC, 160,000x; HC, 400,000x) before a 150 µL aliquot was transferred to a 96 well plate. HPLC analysis was performed using an Agilent 1260 Infinity system with a Poroshell 120 EC-C18 column (3.0 x 50 mm with 2.7 µm; Agilent Technologies, Mississauga, ON) at 25°C with the detector set at an excitation wavelength 375 nm and emission wavelength 435 nm. Mobile phase A consisted of 25 mM sodium phosphate (pH 7.0) and methanol (90:10 vol/vol), while mobile phase B consisted of 25 mM sodium phosphate (pH 7.0) and methanol (30:70 vol/vol). Prior to injection, online sample derivatization (methanol, sample, and 1.2 mM potassium ferricyanide in 15% wt/vol sodium hydroxide) was performed by automated injector programming. THCl (as equivalents in fish sauce) was quantified based on peak area and external standardization using THCl calibration solutions (0-20 g/L; Sigma-Aldrich, Oakville, ON).

3.3.4 Sensory evaluation

3.3.4.1 Participants

A convenience sample of 90 women of childbearing age (18-45 y) was recruited from the Prey Veng provincial market in Prey Veng Town, Prey Veng, Cambodia, over two days, 7 days after fish sauce was bottled. Women were selected as consumer panelists because they are the primary end-users (cooks) in rural Cambodia, and therefore deemed most likely to perceive sensory differences between fish sauces. Ethics approval was obtained from the National Ethics Committee for Health Research (0245NECHR) in Cambodia,

and the University of British Columbia Clinical Research Ethics Board (H14-02173) in Canada. Written informed consent was obtained from all women.

3.3.4.2 Study procedure

Women completed a discriminative test, the Triangle Test, and two affective tests, the Paired Preference Test and the Nine Point Hedonic Scale (110,111). These simple sensory evaluation tests were chosen because they can be completed by minimally trained consumer panelists (112). Before sensory evaluation, women were asked demographic questions including their age, and questions regarding general attitudes towards fish sauce and typical fish sauce consumption behaviours (see questionnaire in Appendix B).

Women determined the time between tests based on their feeling of preparedness for the next tasting. Two trained interviewers conducted sensory evaluation in Khmer language and recorded all responses. Women were blinded to fish sauce samples, and all sauce was served in identical 30 mL plastic cups containing 5 mL of fish sauce at ambient temperature (~25-28°C). A bottle of water and unsalted crackers were provided to women to cleanse their mouths between samples. Women were informed that we were seeking an honest and free expression of their opinions towards the fish sauce samples, and that there were no correct answers to any of the tests employed.

3.3.4.3 Triangle test

The goal of the Triangle Test is to determine whether statistically significant sensory differences exist between two fish sauces (112). Women were given three samples, two

the same and one different, and asked to identify the different sample (110). The probability of the woman selecting the different sample by chance alone is one third (110). Women were randomly assigned to receive one of six possible triangle test sample combinations (sets). Three coded samples were provided to each woman at one time, and she was asked to identify the different sample.

3.3.4.4 Paired preference test

In the Paired Preference Test, women were asked to taste two products and identify the preferred sample (111). Only control and HC fish sauces were assessed because if any difference in sensory preference truly existed due to the added THCl, these differences would likely be most apparent between control and HC rather than LC. The order of presentation of control and HC fish sauce was random.

3.3.4.5 Nine point hedonic scale

Neither the Triangle Test nor the Paired Preference Test allows women to describe whether they 'liked' or disliked' the products sampled (111), so a Nine Point Hedonic Scale was also employed. This scale is a simple, accurate, and reliable means of assessing likes and dislikes of a wide range of foodstuffs and beverages (112) across a range of populations of untrained consumer panelists (113). In this test women were asked to taste the three fish sauce samples, one at a time, and assess their degree of liking or disliking each sample using the following nine-point scale: (1) dislike extremely; (2) dislike very much; (3) dislike moderately; (4) dislike slightly; (5) neither like nor dislike; (6) like slightly; (7) like moderately; (8) like very much; or (9) like extremely (113). In Khmer

language, liking or disliking food translates to how delicious that food is perceived to be, therefore the Khmer translation of this scale ranged from “extremely not delicious” to “extremely delicious”. Women tasted samples one at a time in a randomized order and were asked to verbally score the samples.

3.4 Statistical analysis

Descriptive statistics were computed for THCl analysis and expressed as means ± SD (g THCl /L fish sauce). For sensory analysis, means ± SD or *n* (%) were computed for demographic characteristics, general attitudes and consumption patterns of fish sauce, and all sensory tests. For the Triangle Test, results were divided into groups based on the different sample in the set. The critical number of correct responses to determine whether the different sample was chosen by chance alone (one tailed p=1/3; n=30) was 15 women (*P*=0.043) (114). That is, if 15 or more women correctly identified the different sample, there is said to be a discernable sensory difference. For the Paired Preference test analysis, a binomial test with a test proportion of 0.5 was used to determine whether there was a statistically significant difference in the proportion of women who preferred control or HC fish sauce. Results were considered significant at $P<0.05$. All analyses were performed using SPSS for Macintosh version 22.0 (IBM Corp., Armonk, NY).

3.5 Results

3.5.1 Fish sauce fortification at factory

The average THCl concentration of LC and HC fish sauces (*n*=10 each, analyzed in triplicate) was 2.0 ± 0.15 and 8.7 ± 0.3 g/L, respectively. The control fish sauce (*n*=7) did

not contain any detectable thiamin. There was random variation in the thiamin concentrations throughout the bottling process: the THCl content of samples compared to the added fortificant ranged between 81 – 101% in LC fish sauce (of 2.2 g/L) and 93 – 104% in HC fish sauce (of 8.8 g/L).

3.5.2 Exposure to light, oxygen, and heat

Thiamin concentrations of fish sauce samples after exposure to light, oxygen, both light and oxygen, and heat, can be found in **Figure 3-2**. Duplicate samples were measured at each time point; ± 10% THCl from baseline mean (calculated from triplicate samples) is shown with dotted lines. There was minimal THCl loss greater than 10% across all exposures. Little THCl degradation was seen after cooking at 100°C for up to 35 min, especially with HC fish sauce.

3.5.3 Household storage

THCl concentrations of fish sauce stored and utilized in rural Cambodian households over 6 months can be found in

Figure 3-3 (expressed as mean ± SD for each time point). THCl varied more amongst HC samples than LC samples. Mean ± SD over six months was 2.3 ± 0.4 g/L and 9.7 ± 1.0 g/L for LC and HC fish sauces, respectively (n=53 each). Interestingly, these means are higher than the mean TCHl concentrations from samples off the bottling line (LC: 2.0 ± 0.15 g/L and HC: 8.7 ± 0.3 g/L), indicating variability across samples. However, only two LC fish sauce samples (collected from households at weeks 20 and 24) measured less than 2 g/L, and no HC samples were less than 8 g/L.

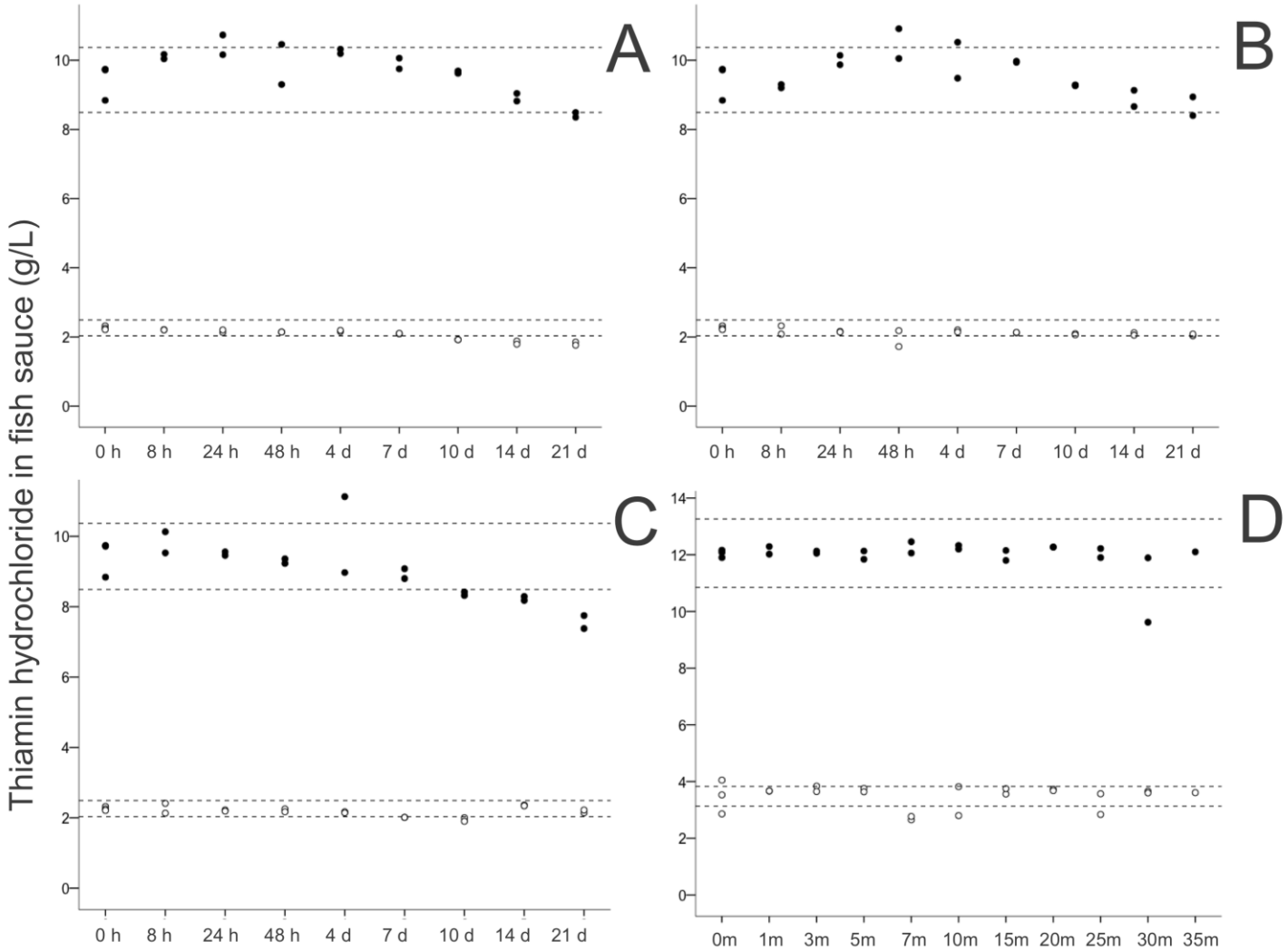


Figure 3-2: Thiamin hydrochloride concentrations (g/L) of fish sauce sample duplicates after laboratory exposure to light (A), oxygen (B), light and oxygen (C) and heat (D; 100°C). LC,O; HC ,●; dotted lines show baseline mean ± 10%; m, minutes; h, hours; d, days.

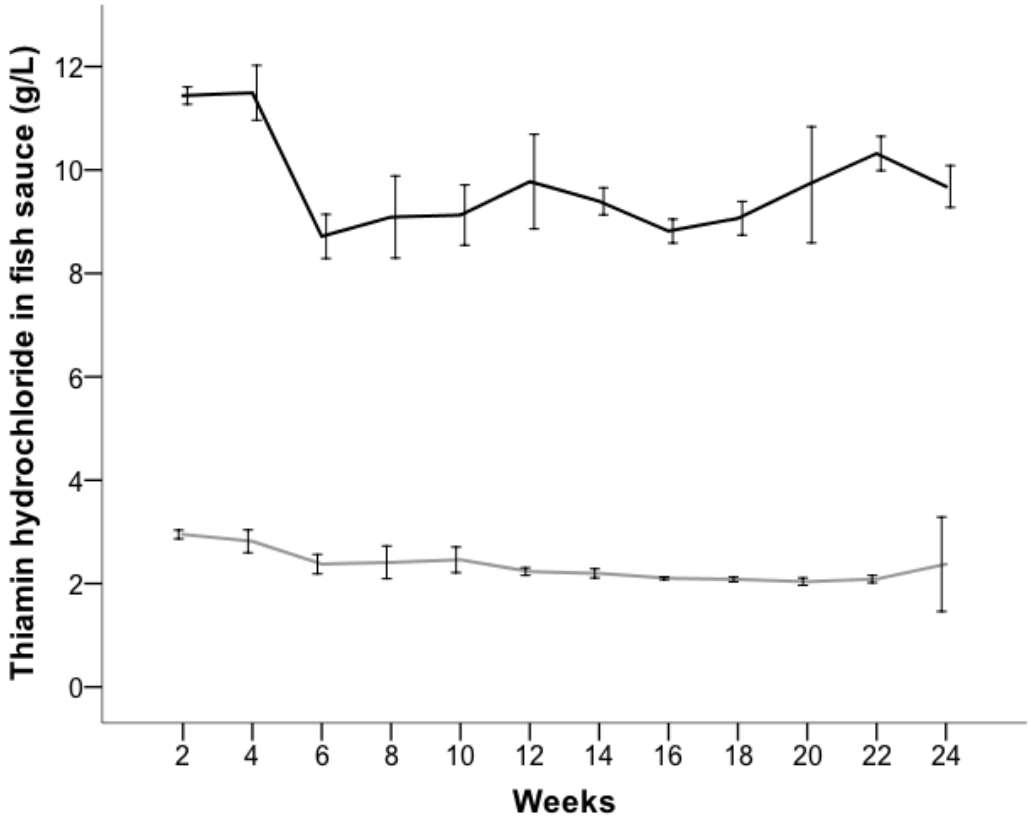


Figure 3-3: Thiamin hydrochloride concentration of fish sauce (g/L) collected fortnightly from households in Prey Veng province, Cambodia over 6 months. Mean ± SD at each timepoint: LC, grey line; HC, black line; *n*=53 each, *n*=4-5 samples per collection timepoint.

3.5.4 Sensory analysis

Demographic characteristics of women who participated in sensory evaluation of the formulated fish sauces can be found in **Table 3-1**. As expected based on the convenience sampling method deployed, the majority (94%) of women had a positive attitude towards fish sauce, while no women had negative feelings. All 90 women reported consumption of fish sauce on a regular basis, and 81% purchased fish sauce regularly.

Table 3-1: Demographic characteristics and general attitudes towards fish sauce of rural Cambodian women (18-45 y; *n*=90)

Demographic Characteristic	Mean ± SD or *n* (%)
Age, *years*	34 ± 8
Pregnant	4 (4)
General Attitude Towards Fish Sauce	
Negative	0 (0)
Neutral	5 (6)
Positive	85 (94)
Fish sauce consumed regularly	90 (100)
Fish sauce purchased regularly	73 (81)

For HC, LC, and control, respectively, 11, 8, and 11 women correctly identified the different sample in the Triangle Test (**Table 3-2**). Since fewer than 15 women correctly identified the different sample we reject the assumption that statistically significant sensory differences existed: women could not discern the fish sauces. While more women preferred control (*n*=54; 60%) to HC fish sauce (*n*=36; 40%) in the Paired Preference Test, this was not significantly different (*P*=0.07).

Table 3-2: Correctly identified 'different' sample in Triangle Test by rural Cambodian women (18-45 y; *n*=90)

Different Sample in Triangle Test Set	*n*	Different Sample Correctly Identified[1]	*P*[2]
Control	30	11 (37)	0.415
Low concentration	30	8 (27)	0.833
High concentration	30	11 (37)	0.415

[1] Values are number (%)
[2] Probability of obtaining X or more correct responses in Triangle Test (one tailed *P*=1/3; *n*=30) (114)

All fish sauces fared similarly in the Nine Point Hedonic Scale test, with the same mean and standard deviation, median, and range for all three sauces (**Table 3-3**). In general, women tended to like all fish sauces, with nearly 70% obtaining scores ≥ 6 for each fish

sauce. Indeed, 31 women (34%) scored all three fish sauces ≥ 6. Fewer than 20% of women disliked any of the fish sauces.

3.6 Discussion

THCl was stable in fish sauce, both during routine storage and use in rural Cambodian households, and under laboratory exposure conditions designed to mimic household conditions. Based on scores provided during the Nine Point Hedonic Scale test, women liked all three fish sauces evaluated in this study. There was not a significant difference in the proportion of women who preferred control or HC fish sauces, and women were unable to discern the three different fish sauces.

Table 3-3: Sensory evaluation of thiamin-fortified fish sauce by rural Cambodian women (18-45 y; *n*=90) using the Nine-Point Hedonic Scale

Fish Sauce Formulation	Mean ± SD	Range	Median	Mode	Categories of Nine-Point Hedonic Scale[1,2]		
					Dislike	Neutral	Like
Control	6.5 ± 2.1	1 - 9	7	9	14 (~16)	17 (19)	59 (66)
Low concentration	6.5 ± 2.1	1 - 9	7	7	14 (~16)	14 (~16)	62 (69)
High concentration	6.5 ± 2.1	1 - 9	7	9	12 (13)	16 (18)	62 (69)

[1] Values are *n* (%).
[2] Categories of Nine-Point Hedonic Scale: Dislike, scores 1-4; Neutral, score=5; Like, scores 6-9.

The within-batch variation of THCl concentrations from the bottling line (LC, 81 – 101%; HC, 93 – 104%) is not uncommon or unexpected. However, THCl concentrations of LC and HC fish sauce samples collected from households had much wider sample variability, ranging from 1.3 – 3.5 g/L (59 – 159% of target) and 8.2 – 12.0 g/L (93 – 136% of target), respectively. This sample variability could be explained by several factors, including that samples were collected from 106 unique households with different storage conditions (storage on table, in cupboard, sealed, or not properly capped) from bottles at different stages of use (newly opened bottles to final dregs). It could also be that the samples from the bottling line did not capture the true variability in the fish sauce either because an insufficient number of samples were collected, or due to factors such as incomplete fortificant mixing, or potential dilution with fish sauce already in the bottling line. Compared to Ferrazone®, which is similar in consistency to granulated sugar, THCl is much lighter and powdery, more similar to the consistency of powdered sugar. With values as high as 3.5 and 12.0 g/L in LC and HC sauces respectively, it may be that while 30 minutes of mechanical stirring in a 2300 L drum is adequate for Ferrazone®, the THCl may not have fully mixed. However, no factory workers, field staff, or study participants saw clumps of THCl in the mixing drums or in individual bottles. Alternatively, some of this variation may have occurred in the household: THCl may have settled at the bottom of the bottle, so samples taken from nearly empty bottles may have had higher THCl concentrations. Or, if bottles were improperly sealed, fish sauce evaporation may have artificially increased THCl concentrations. Further research should investigate the optimal mixing time of THCl in fish sauce to minimize sample variability, and should examine the effects of evaporation and THCl precipitation.

As shown in **Figure 3-3** very few samples showed losses of more than 10% of baseline measurements. Although thiamin is known to be sensitive to oxygen and heat (38), exposures to these conditions in the laboratory had little effect on thiamin stability within a fish sauce matrix, potentially due to the pH and amino acid content of fish sauce. While nearly 100% of thiamin has been shown to degrade after boiling for 20 minutes at pH 9, little degradation occurs under acidic conditions (38). Therefore the acidic pH of fish sauce (107) was likely protective against thiamin degradation. In addition, the presence of α-amino acids has shown to enhance thiamin stability slightly, even at neutral and alkaline pHs (most notably between pH 4.5 – 7) (104). McIntire & Frost reported 27% thiamin degradation after exposure to 100°C for 4 h at pH 6, but in the presence of glycine this loss decreased to 21% (104). Fish sauce is a rich source of amino acids, containing ~16 g/L fish sauce; a recent analysis revealed 426 mg glycine per 100 mL fish sauce (115). There is debate in the literature surrounding light-induced thiamin degradation. While general consensus is that thiamin, like other B vitamins, is sensitive to light (13,31,38,105), Chen and colleagues reported 26% loss of THCl in a parenteral nutrition solution after exposure to direct sunlight for 8 h, but no degradation after exposure to indirect sunlight and fluorescent light (106). In the context of this study, thiamin was likely protected by the acidic pH and amino acid content of fish sauce, as well as indirect sunlight exposure.

The Nine Point Hedonic Scale can be employed with little training (112), however there is evidence that Asian participants use the scale differently than American panelists, the population group more commonly engaged in sensory analysis (116). Yeh and colleagues compared the use of the Nine Point Hedonic Scale among American, Chinese, Korean, and Thai participants and found that while Americans tend to score more frequently on the extreme ends of the scale

(scores 1-3 and 7-9), Asian participants often use the central scores (scores 4-6) (116). However, while only 9 (10%), 11 (12%) and 10 (11%) of women in this study indicated a score in the lowest tertile of the Nine Point Hedonic Scale (scores 1-3) for HC, LC, and control fish sauces, respectively, a large proportion of women, 50 (56%), 55 (61%), and 51 (57%), scored HC, LC, and control sauces in the highest tertile (scores 7-9), respectively. Therefore, the Cambodian women in this study appeared to make full use of the scale. This difference may be attributed to the popularity of fish sauce among Cambodians (85) especially among this convenience sample of women, of whom 94% reported having a positive attitude towards fish sauce.

MTF and MTF-MTF, common degradation products of thiamin-rich foods have strong meaty flavours (108,109) that may affect consumer acceptability of fortified fish sauce. Since we report minimal thiamin degradation, it is unlikely that MTF and MTF-MTF were produced in high enough quantities to have affected the smell and taste of the fish sauce (117). Indeed, since fish sauce also has a powerful, somewhat meaty flavour (118) it may be that off-flavours caused by MTF and MTF-MTF, if present, were not detected by participants. In addition, the strong salty taste of fish sauce may mask thiamin fortification and thiamin degradation products. Since fish sauce must contain no less than 200 g/L salt (107), it may be that the addition of thiamin as a salt (THCl) at relatively low concentrations (2 and 8 g/L) does not greatly alter the taste of fish sauce, especially considering the strongest taste of fish sauce is saltiness (118).

Fish sauce is one of the most commonly consumed condiments in Cambodia and throughout Southeast Asia (84), making it an ideal vehicle for micronutrient fortification. Both thiamin-iron- and iron-fortified fish sauces were equally well accepted and not discernable by rural women of

childbearing age, the household cooks of Cambodia. As such, there is potential for other micronutrients to be added along with thiamin and iron as a means of combating multiple micronutrient deficiencies in Cambodia and the wider region with a single intervention using pre-existing factory infrastructure.

3.7 Conclusions

This study documents the first stability and sensory evaluation of thiamin-iron-fortified fish sauce. THCl was relatively stable in a fish sauce matrix both during 6 months of typical storage and use in rural Cambodian households, and after exposure to light, oxygen, and heat under laboratory conditions. The fortified fish sauces were well accepted by rural women aged 18 – 45 y in Prey Veng province, Cambodia, with >65% of women liking the sauces (scores ≥ 6 on a Nine-Point Hedonic Scale). There was no significant difference in the preference for control or HC fish sauces, and only approximately one third of women correctly identified the different sample in the Triangle Test, indicating that women were unable to differentiate the three fish sauces. Since the two concentrations of thiamin-iron-fortified fish sauces were both well accepted and not discernable from control fish sauce fortified with only iron, we expect these formulations will be well accepted by future rural Cambodian consumers. If brought to scale, thiamin-iron-fortified fish sauce has the potential to be a sustainable means of combating infantile beriberi in rural Cambodia, and potentially throughout Southeast Asia.

Chapter 4: Household consumption of thiamin-fortified fish sauce increases erythrocyte thiamin concentrations in rural Cambodian women and their children under 5 years: a randomized controlled trial

4.1 Summary

Background: Poor thiamin status is prevalent in rural Cambodia due to heavy consumption of thiamin-poor white rice and a lack of dietary diversity, which could lead to potentially fatal infantile beriberi among breastfed infants. In regions where dietary thiamin intake is adequate, women of childbearing age are purportedly thiamin-replete and beriberi is uncommon.

Objective: To determine whether *ad libitum* consumption of thiamin-fortified fish sauce over six months could increase erythrocyte thiamin diphosphate concentrations (eTDP) among women of childbearing age and their youngest children aged 12-59 mo, compared to control sauce containing no thiamin.

Methods: In this double-blind, randomized controlled efficacy trial 276 non-pregnant, non-lactating women aged 18-45 y and their families in Prey Veng, Cambodia, were individually randomized to receive one of three fish sauce formulations: low concentration (LC, 2 g/L), high concentration (HC, 8 g/L), or a control sauce. eTDP was measured using HPLC-FLD.

Results: Fish sauce consumption did not differ among treatment groups (P=0.19). In intent-to-treat analysis, women's baseline-adjusted endline eTDP (estimated marginal mean; 95% CI) was significantly higher among women in LC (232; 220, 244 nM) and HC (231; 219, 244 nM) groups compared to control (175; 163, 188 nM; P<0.001). Similarly, baseline-adjusted eTDP was significantly higher among children in LC (243; 233, 254 nM) and HC (229; 219, 240 nM) groups compared to control (212; 202, 223 nM; P<0.05).

Conclusions: Women and their children who consumed thiamin-fortified fish sauce at concentrations of 2 and 8 g/L for six months had significantly higher eTDP compared to those consuming a control fish sauce.

4.2 Introduction

Infantile beriberi, a potentially fatal disease caused by a lack of thiamin (vitamin B_1) among breastfed infants aged 2-4 months (13,57), was common amongst Karen refugees living in camps on the Thai-Burmese border in the 1980s (68,70). Thiamin deficiency is most serious and life-threatening in infants (67) because the developing brain is highly sensitive to the effects of deficiency (13). Low maternal dietary thiamin intake results in thiamin-poor breast milk (57); unfortunately mothers of infants with beriberi are often asymptomatic (11,13,67). Increasing the thiamin intake and status of lactating women could prevent infantile beriberi and related infant mortality. Maternal thiamin supplementation addressed infantile beriberi in these refugee camps (68), but thiamin deficiency remains a public health concern in this region (11,29,45,77,78,93,95) where B-vitamin poor, polished white rice is the dietary staple (119,120). Elsewhere, infantile beriberi has been nearly eradicated through diverse diets, and/or thiamin fortification or enrichment (36,37,64,87,88). In Cambodia, where non-parboiled (44), polished white rice is estimated to account for up to 60% of dietary energy (8) and dietary diversity is low (1,5,120), reports of beriberi are not uncommon (11). We recently reported that erythrocyte thiamin diphosphate concentrations (eTDP) were significantly lower among non-pregnant, non-lactating rural Cambodian women of childbearing age than purportedly B-vitamin replete Canadian women (93).

Strategies may be needed to improve thiamin intake in Southeast Asia (89). In rural Cambodia where there is limited access to thiamin-rich foods such as whole grains and animal-source foods (1,46), thiamin fortification could be a sustainable, low cost (102), and passive approach to improve thiamin status (87). Fortification of fish sauce, a popular traditional condiment already used as a fortification vehicle for iron (84,85,102,103,121), is a population-wide intervention that has the potential to improve the thiamin intake not only of lactating women for the prevention of infantile beriberi, but of all consumers. Since beriberi is uncommon in populations with adequate thiamin intake, the aim of this study was to determine whether *ad libitum* consumption of a newly formulated thiamin-fortified fish sauce for six months would yield higher eTDP among rural Cambodian women of childbearing age and their children under 5 years compared to those who consumed a control fish sauce containing no thiamin.

4.3 Methods

4.3.1 Study design

This was a community-based, double-blind, randomized controlled efficacy trial, where we recruited women and their families from villages in Prey Veng province, Cambodia. Villages participating in other non-governmental nutrition-related programs were excluded. Using village registries, all female-heads-of-household aged 18-45 y with at least one child between 12-59 mo were invited to participate in the study. Women were excluded if they were taking a thiamin-containing supplement, planned to leave their village (i.e. for work) during the next six months, or if they did not agree to exclusively use the study fish sauce. Women provided informed written consent on behalf of themselves and their child. Ethical approval was obtained from the

National Ethics Committee for Health Research in Cambodia (0245NECHR) and the University of British Columbia Clinical Research Ethics Board in Canada (H14-00103).

4.3.2 Fish sauce

In partnership with local fish sauce producer Leang Leng Enterprises (Phnom Penh, Cambodia), we produced three fish sauce formulations for this study: low concentration thiamin (LC; 2 g/L thiamin hydrochloride (THCl; ≥ 98% purity), Huazhong Pharmaceutical Co., Ltd, China, donated by Natural Factors, Coquitlam, British Columbia, Canada), high concentration thiamin (HC; 8 g/L THCl), and control, which had no detectable thiamin. Thiamin fortification dose in fish sauce is discussed in *3.3.1*. All fish sauces were fortified with iron as ferric sodium ethylenediaminetetraacetate (2.8 g/L Ferrazone®, Akzo Nobel Functional Chemicals B.V., The Netherlands) as per Cambodian Ministry of Planning guidelines (86). Fish sauce was pasteurized for 90-120 min at 100°C in 2300 L drums, cooled to room temperature, and then fortificants were added and mixed for 30 min before bottling. All fish sauce used in the study received Cambodian Ministry of Health Certification for Hygienic Food Production.

Fish sauce packaging was identical among the three groups except for a unique serial number stamp on each bottle, and different coloured caps for different study arms intended to prevent confusion amongst field staff and participants. Green, orange, and purple caps were selected based on feedback from 12 focus group discussions (n=60 women aged 18-45 y from 12 villages within 3 communes in Prey Veng, Cambodia; see semi-structured guide in Appendix C), which highlighted these colours as pleasant yet culturally and politically neutral in Cambodia. The blinding code was known to Leang Leng Enterprises, and was stored in a sealed envelope held

by the Principal Investigator in case of emergency. Sensory evaluation using the triangle test (110) indicated that rural Cambodian women (n=90) were unable to discern the three formulations of fish sauce.

4.3.3 Randomization

Before study recruitment, a master ID list was created with group assignments using online randomization software (GraphPad Software Inc., La Jolla, CA) to allow for non-stratified, individual, equal randomization to arms. Cambodian field staff then assigned ID numbers sequentially during baseline data collection. Women received their first fish sauce after baseline blood collection, then every two weeks thereafter during household visits from field staff. Women were instructed to consume the study fish sauce *ad libitum* as they normally would; since Cambodian families eat family-style from a common pot, the entire household consumed the study fish sauce during the 6 month intervention. In November 2014 (t=1 mo), all study participants and their family members (husbands, sisters, mothers, mothers-in-law etc.) were invited to a nutrition education workshop in their village where they learned about thiamin deficiency and beriberi, as well as infant and young child feeding practices according to Cambodian Ministry of Health guidelines (81).

4.3.4 Weighed fish sauce record

To obtain accurate fish sauce intake data we conducted a weighed fish sauce record with a randomly selected subset of 28 households from the three treatment groups. A trained enumerator weighed all fish sauce consumed by the mother, husband, and youngest child aged 12-59 mo between dawn and dusk (~12 hours) on three non-consecutive days (two week days,

one weekend day; different enumerators for each day) within a two week window. The family was instructed to continue with their day normally; if the family cooked with fish sauce the enumerator weighed the meal and individual meal servings using a battery-powered electronic balance (Salter Aquatronic, Oak Brook, IL, USA). Fish sauce consumption was calculated by multiplying the weight of fish sauce-containing food consumed by the amount of fish sauce added to the meal (see Appendix D). Data were collected in December 2014 (t=2 mo) to document consumption during early dry season to balance seasonal dietary intake (mid-point between lean and rich seasons), and to avoid the potential increased fish sauce consumption at the beginning of the study due to the novelty of receiving free fish sauce.

4.3.5 Data and blood collection

Demographic, dietary, and subjective information regarding fish sauce was collected at baseline (October 6-17, 2014) and endline (t=6 mo; April 22-29, 2015) using an interviewer-administered questionnaire in women's homes (see questionnaire in Appendix E). The next morning a non-fasting venous blood sample was collected into evacuated EDTA-coated tubes (Vacutainer, Becton Dickinson; Mississauga, ON) from each woman and her youngest child aged 12-59 mo at a central village location. Blood was stored on ice, and was transported within 5 h to the National Institute for Public Health (NIPH) laboratories in Phnom Penh for processing. Blood samples were centrifuged at 3000 rpm for 15 min at 4°C, and plasma and buffy coat were removed. Erythrocytes were washed three times with phosphate buffered saline (Amresco; Solon, OH) and stored at -80°C. Baseline and endline blood samples were batch shipped on dry ice to the University of British Columbia (UBC) in Vancouver, Canada in June 2015.

4.3.6 Biochemical thiamin analysis

eTDP was measured at UBC using reverse-phase high performance liquid chromatography with a fluorescence detector (HPLC-FLD) according to Lu & Frank (51), with modifications. Briefly, 500 µL of 10% wt/vol trichloroacetic acid in deionized water was added to a mixture of 250 µL previously frozen packed erythrocytes and 250 µL deionized water. Samples were vigorously vortex mixed, placed on ice for 15 min, and then centifuged (13000 *g*, 10 min). An aliquot of supernatant (500 µL) was washed twice with 750 µL of water saturated methyl-tert-butyl ether. From the aqueous layer, a 150 µL aliquot was then transferred to a 96 well plate. HPLC analysis was performed using an Agilent 1260 Infinity system with a Poroshell 120 EC-C18 column (3.0 x 50 mm with 2.7 µm; Agilent Technologies, Mississauga, ON) at 25°C with the detector set at an excitation wavelength 375 nm and emission wavelength 435 nm. Mobile phase A consisted of 25 nM sodium phosphate (pH 7.0) and methanol (90:10 vol/vol), while mobile phase B consisted of 25 nM sodium phosphate (pH 7.0) and methanol (30:70 vol/vol). Prior to injection, online sample derivatization (methanol, sample, and 1.2 nM potassium ferricyanide in 15% wt/vol sodium hydroxide) was performed by automated injector programming. Quantitation of eTDP was based on peak area and external standardization using TDP calibration solutions (range ~20-800 nM; Sigma-Aldrich; recoveries of low (20 nM) and high (800 nM) standards in deionized water were 102.5% and 93.2%, respectively). Quality controls were conducted on each run using pooled erythrocytes from ten healthy Canadian adults (inter-run CVs <9%, n=17).

4.3.7 Data analysis

We estimated a sample size of n=92 mothers per group would be sufficient to observe a 10% difference between fortified and control groups at endline assuming a minimum baseline of 38

nM (93), standard deviation=18 nM (122), 80% power, alpha=0.05, with a 2-sided test, assuming a 15% attrition rate. Participant characteristics and attitudes were summarized as mean ± SD for continuous variables, and as *n* (%) for categorical variables. In intent-to-treat analysis (ITT), baseline eTDP values were carried forward when endline data were missing. In as-treated analysis, only participants with complete data were included in analysis. All analyses refer to ITT unless otherwise stated.

General linear models (GLM) were used to assess differences between fortified groups (LC and HC) compared to the control group (reference). GLM were used to assess endline eTDP (adjusted for baseline), and fish sauce consumption. Post-hoc analysis with least significant difference (LSD) adjustment for multiple comparisons was used to assess differences between the three treatment groups: LC, HC, and control. GLM (run separately for LC and HC groups) were used to assess differences in both endline eTDP and eTDP change between baseline and endline, by baseline eTDP tertile (lowest tertile as reference group; post-hoc analysis with LSD for comparison between three tertiles). Estimated marginal means (95% CI) are reported for GLM. All analyses were performed with SPSS for Macintosh version 23.0 (IBM Corp., Armonk, NY), with a significance level of $P<0.05$.

4.4 Results

Participant recruitment, flow and follow-up is shown in **Figure 4-1**. Of the 427 women screened for participation, 276 mother-child dyads were enrolled in the study and randomly assigned to control, LC, and HC (*n*=92, *n*=93, and *n*=91, respectively). At the end of the study 197 mothers remained resulting in an overall attrition rate of 29%, with no differences by treatment group

(control, *n*=27; LC, *n*=26; HC, *n*=26). Moving away for work, usually temporarily, was the main reason women were lost to follow-up (18%, *n*=49: control, *n*=13; LC, *n*=19; HC, *n*=17).

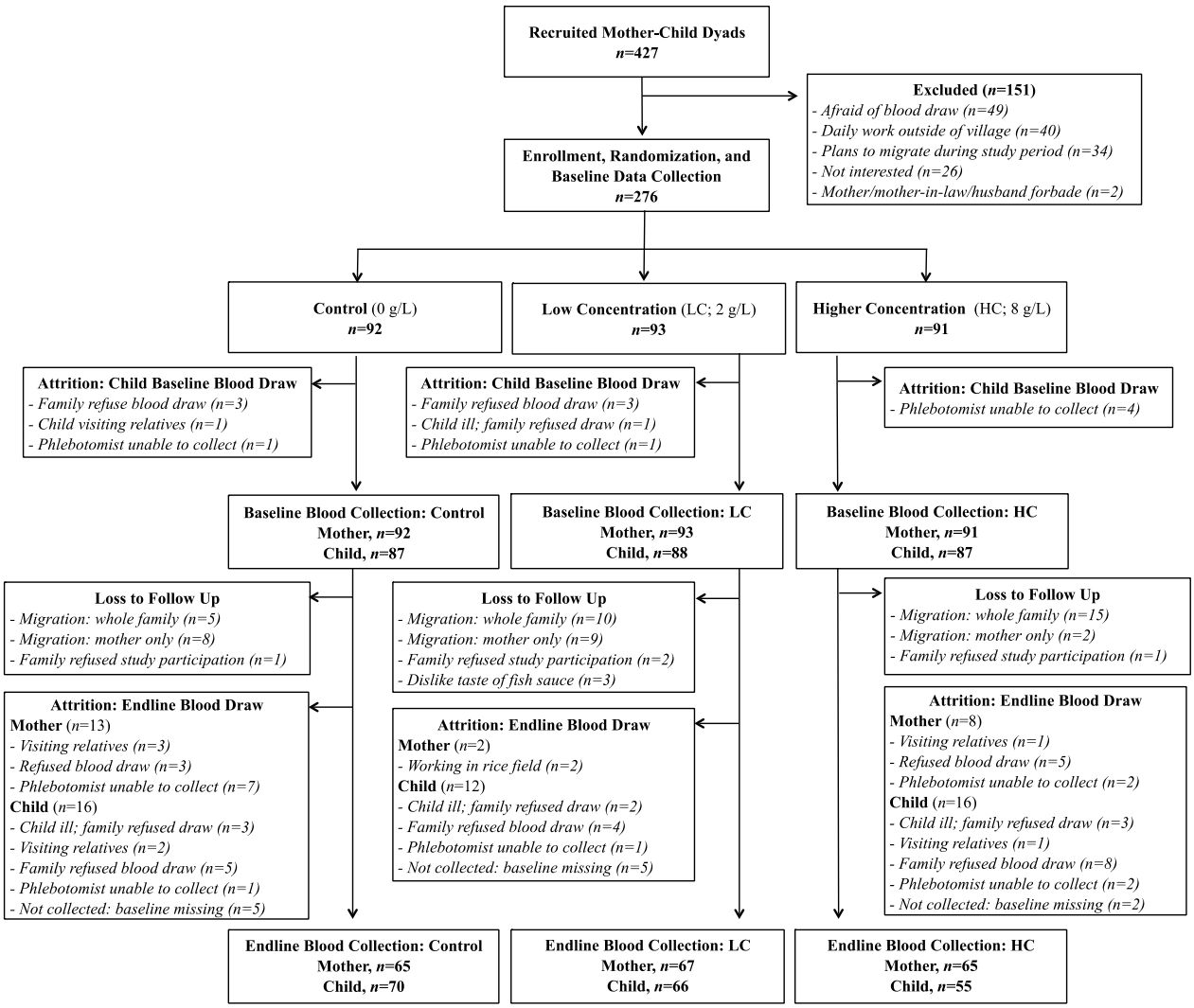


Figure 4-1: Participant flow and follow-up of Cambodian women (18-45 y) and their youngest child (12-59 mo) in Prey Veng, Cambodia

Baseline characteristics of mothers, children, and their households can be found in

Table 4-1. The mean age of women was 30 ± 6 y, and most of the women had a normal BMI (18.51-24.99 kg/m^2). Households typically had 5 ± 2 people, with a relatively high mean annual

household income of US$1,906 ± 1,903 with 49% (*n*=136) of households within the top 20% of incomes in Prey Veng province (99).

Table 4-1: Baseline characteristics of Cambodian women (18-45 y), their youngest children (12-59 mo), and their households[1]

	Control *n*=92	**Low Concentration *n*=93**	**High Concentration *n*=91**
Mothers			
Age, *y*	30 ± 6	30 ± 6	30 ± 7
Body mass index, *kg/m²*	21.8 ± 3.5	21.8 ± 3.3	22.3 ± 3.1
Underweight (≤ 18.5)	12 (13)	13 (14)	8 (9)
Normal (18.51-24.99)	63 (69)	67 (72)	67 (74)
Overweight (25-29.99)	15 (16)	11 (12)	14 (15)
Obese (≥ 30)	2 (2)	2 (2)	2 (2)
Education			
None	8 (9)	7 (8)	12 (13)
Primary (years 1-6)	55 (60)	47 (50)	35 (38)
Lower Secondary (years 7-9)	19 (21)	29 (31)	36 (40)
Upper Secondary (years 10-12)	10 (10)	9 (10)	7 (8)
Higher Education	-	1 (1)	1 (1)
eTDP, *nM*	150 ± 39	172 ± 53	179 ± 59
Children			
Sex, *female*[2]	29 (26)	33 (40)	32 (43)
Age, *mo*	35 ± 14	32 ± 14	31 ± 13
eTDP, *nM*[3]	172 ± 43	194 ± 55	211 ± 65
Households			
Household population	5 ± 2	5 ± 2	5 ± 2
Annual household income, *US$*[4]	1,678 ± 1,614	2,119 ± 2,013	1,917 ± 2,047
Bottom 20%	12 (13)	9 (10)	14 (15)
Middle 60%	39 (42)	31 (33)	35 (39)
Top 20%	41 (45)	53 (57)	42 (46)

[1] mean ± SD or *n* (%). eTDP, erythrocyte thiamin diphosphate concentration.
[2] Data collected at endline; control, *n*=81; LC, *n*=82; HC, *n*=75.
[3] Control, *n*=87; LC, *n*=88; HC, *n*=87
[4] Households were classified using 2011 income quintiles from Prey Veng province, Cambodia (99)

Maternal and child endline eTDP can be found in **Table 4-2**. In intent-to-treat analysis, after 6 months women in LC and HC groups had significantly higher baseline-adjusted eTDP (mean,

95% CI) of 232 nM (220, 244) and 231 nM (219, 244), respectively, than control, 175 nM (163, 188; $P<0.001$). There was no significant difference in baseline-adjusted eTDP between women receiving the two fortified fish sauces, LC and HC ($P=0.97$). Similarly, at endline children's eTDP was significantly higher in the LC (243; 233, 254 nM) and HC (229; 219, 240 nM) groups compared to control (212; 202, 223 nM; $P<0.05$), and there was no difference between HC and LC groups ($P=0.06$). As-treated analysis did not markedly change the findings (see **Table 4-2**).

Endline eTDP for mothers and children stratified by baseline eTDP tertile is shown **in Figure 4-2**. LC women in the highest tertile at baseline had significantly higher endline eTDP ($P<0.001$) compared to the lower tertiles; those in the lower two tertiles at baseline did not have different mean endline eTDP ($P=0.07$; Panel A). Among HC women, those in the highest tertile at baseline had significantly higher endline eTDP than those who started in the lowest tertile ($P<0.001$; Panel B). Among women in the LC group, the rate of change between baseline and endline eTDP did not differ by baseline tertile ($P=0.50$). However, among women in the HC group, the mean (95%) change in eTDP between baseline and endline was significantly higher among women in the lowest tertile, 88 nM (61, 115) compared to women in the highest baseline tertile, 34 nM (7, 61; $P=0.006$). Mean endline eTDP among both LC and HC children differed significantly among all three tertiles ($P<0.001$; Panels C and D). Neither HC nor LC group children had different rates of change in eTDP between baseline and endline by baseline tertile (LC, $P=0.52$; HC, $P=0.19$).

Results of the weighed fish sauce record are given in **Table 4-3**. Overall, consumption did not differ by treatment arm (mothers, $P=0.80$; husbands, $P=0.24$; children, $P=0.54$). Fish sauce

consumption was highly variable, with ranges in consumption between 0 – 81 mL per day among mothers. The overall number of bottles of fish sauce consumed over the six month study was not significantly different between treatment groups: control and LC, 13 (12, 14) bottles, and HC, 12 (11, 13) bottles (P=0.19). Most participants (n=142, 72%) self-reported increased household fish sauce consumption during the study period, with the majority indicating a slight (n=51, 36%) or a large (n=84, 59%) increase. Only 8 women (6%) attributed this increase in fish sauce consumption to the fact that fish sauce was free: the majority of women (n=114, 86%) credited the "delicious taste" of the study fish sauce. Ninety-six percent of women indicated that they would purchase thiamin-fortified fish sauce if it became available at market, mostly due to its organoleptic properties (n=140, 74%), but also because they believed it could improve the health of their family (n=45, 24%).

Table 4-2: Maternal and child eTDP at endline (6 mo)[1]

	β	SE	*P value*	*n*	Estimated Marginal Means (95% CI)[2]
Mothers					
Intent-to-Treat[3]					
Control	(Ref)	-	-	92	175 (163, 188)[a]
Low concentration	57	9	<0.001	93	232 (220, 244)[b]
High concentration	56	9	<0.001	91	231 (219, 244)[b]
As Treated[4]					
Control	(Ref)	-	-	65	183 (167, 198)[a]
Low concentration	78	11	<0.001	67	260 (246, 275)[b]
High concentration	75	11	<0.001	65	258 (243, 273)[b]
Children					
Intent-to-Treat[3]					
Control	(Ref)	-	-	87	212 (202, 223)[a]
Low concentration	31	8	0.031	88	243 (233, 254)[b]
High concentration	17	8	<0.001	87	229 (219, 240)[b*]
As Treated[4]					
Control	(Ref)	-	-	70	215 (203, 227)[a]
Low concentration	46	9	<0.001	66	261 (249, 273)[b]
High concentration	42	10	<0.001	55	257 (243, 271)[b]

[1] A general linear model adjusted for baseline eTDP was used to assess differences between fortified groups (LC and HC) compared to control group (reference). eTDP, erythrocyte thiamin diphosphate (nM)

[2] Post-hoc analysis (with LSD adjustment for multiple comparisons) assessed differences between LC, HC, and control groups; values that do not share a common superscript differ significantly, $P<0.001$; $*P<0.05$.

[3] In intent-to-treat analysis, baseline values were carried forward for missing endline values.

[4] In as-treated analysis, a total of $n=79$ women and $n=71$ children were excluded from analyses due to attrition, blood draw refusal, and inability to draw blood (on behalf of phlebotomist).

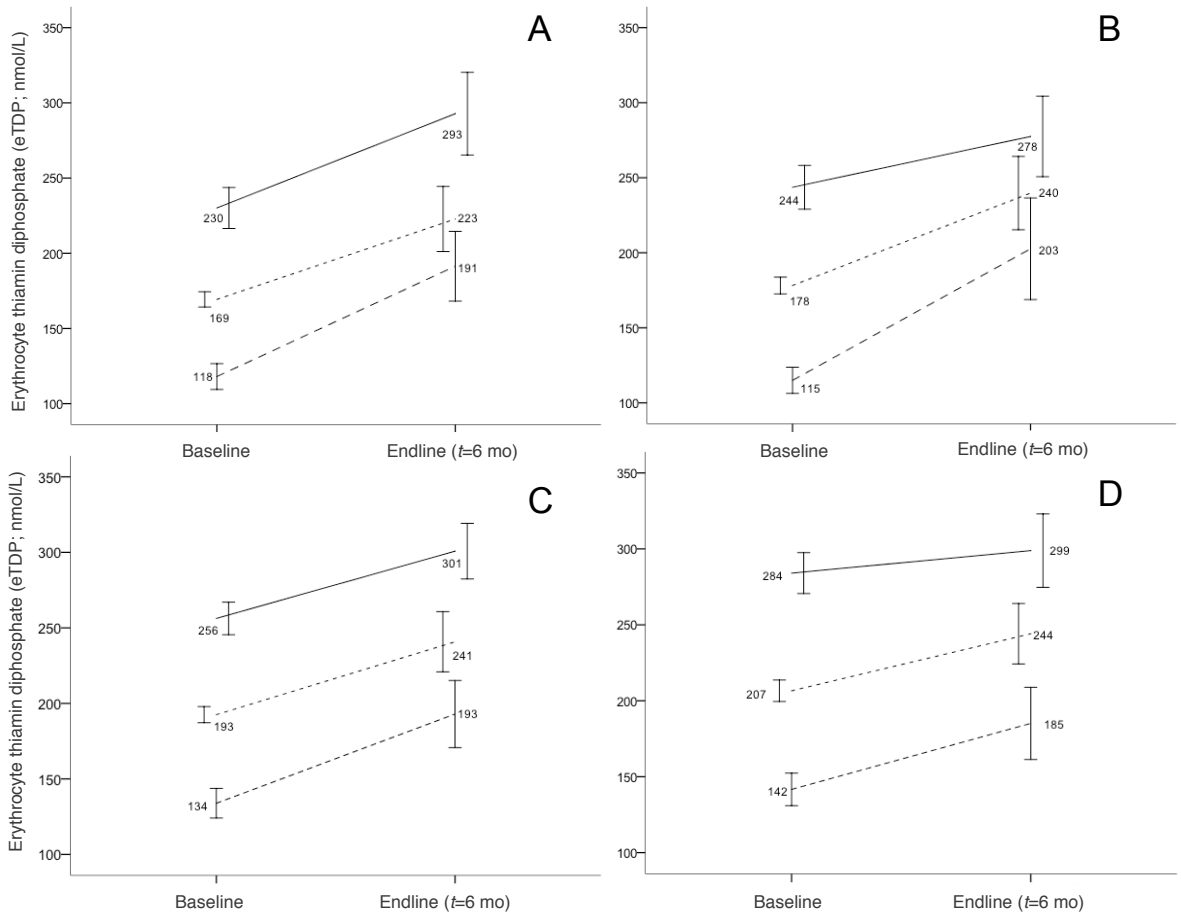


Figure 4-2: Mean (95% CI) erythrocyte thiamin diphosphate concentrations (eTDP, nM) of women and their children aged 12-59 mo at baseline and endline (*t*=6 mo) stratified by baseline eTDP tertile (lowest tertile: __ __ __; middle tertile: _ _ _ ; highest tertile: ___). Panels: A, women low concentration group; B, women high concentration group; C, children low concentration group; D, children high concentration group.

Table 4-3: Daily fish sauce consumption (mL/d) and thiamin intake (mg/d) from fish sauce of women, their husbands, and their children (12-59 mo) collected from the three day weighed fish sauce records, by meal preparation method

	Woman			Husband			Child		
	n	**Mean ± SD**	**Range**	***n***	**Mean ± SD**	**Range**	***n***	**Mean ± SD**	**Range**
Control									
Daily Fish Sauce Consumption	27	14 ± 17	1 - 60	18	12 ± 11	0 - 34	26	4 ± 6	0 - 24
Stir fry	13	3 ± 2	0.7 - 7	8	4 ± 3	0.7 - 9	9	1 ± 1	0.1 - 3
Condiment	12	24 ± 16	2 - 55	8	16 ± 8	7 – 27	10	8 ± 6	3 – 23
Soup	14	4 ± 4	0.4 - 11	8	4 ± 4	0.4 – 11	12	1 ± 2	0.1 – 7
Other[1]	3	3 ± 4	0.4 - 7	2	4 ± 6	0.2 - 8	2	2 ± 2	0.3 - 3
Daily Thiamin Intake	-	-	-	-	-	-	-	-	-
Low Concentration									
Daily Fish Sauce Consumption	26	18 ± 21	0 - 81	10	25 ± 28	5 - 93	27	4 ± 5	0 - 26
Stir fry	14	5 ± 5	0.4 – 22	6	5 ± 1	2 - 6	13	2 ± 2	0.3 – 7
Condiment	5	32 ± 24	11 – 69	2	14 ± 8	8 – 20	4	4 ± 2	2 - 6
Soup	13	12 ± 13	1 - 33	6	23 ± 27	3 - 73	10	4 ± 5	0.1 – 15
Other[1]	10	8 ± 10	0.3 - 31	4	14 ± 14	0.9 - 32	6	3 ± 4	0.2 - 11
Daily Thiamin Intake	26	36 ± 42	0 - 162	10	49 ± 55	10 - 185	27	8 ± 11	0 - 52
High Concentration									
Daily Fish Sauce Consumption	25	16 ± 19	0 - 78	14	18 ± 22	0 - 68	26	6 ± 8	0 - 33
Stir fry	13	8 ± 10	1 – 41	7	8 ± 6	3 - 17	12	5 ± 4	0.3 - 33
Condiment	2	12 ± 0.7	11 – 12	1	2	-	1	2	-
Soup	12	14 ± 13	1 – 47	4	33 ± 16	21 – 54	12	5 ± 4	0.5 – 14
Other[1]	6	16 ± 11	4 - 31	3	18 ± 14	4 - 32	6	5 ± 8	0.3 - 22
Daily Thiamin Intake	25	127 ± 153	0 - 626	14	147 ± 178	0 - 540	26	47 ± 67	0 - 262

[1] Includes dishes such as Teuk Trey Ph'aem or Teuk Kroeung

4.5 Discussion

An estimated 90% of the Cambodian population consumes fish sauce (85), making it an ideal vehicle for micronutrient fortification. Indeed, fish sauce fortified with iron has been tested and is currently being sold in Cambodia (84–86) and throughout the region (102,103). We found that thiamin-fortified fish sauce is an efficacious means of increasing dietary thiamin intake and biochemical thiamin status among women of childbearing age and their young children in rural Cambodia. Women consuming a thiamin-fortified fish sauce had higher baseline-adjusted eTDP at endline compared to women consuming the control fish sauce ($P<0.001$). Since infantile beriberi, a potentially fatal disease in breastfed infants (13), remains an issue in Cambodia (11), increasing the thiamin intake and status of women of reproductive age could prevent these infant deaths (57). While this target group is a priority, thiamin fortification has the potential to benefit all consumers by preventing marginal thiamin deficiency, which causes apathy, fatigue, loss of appetite, and dizziness (45), and may be common in other at-risk groups such as the elderly (22).

Neither maternal nor child baseline-adjusted endline eTDP differed significantly between LC and HC, indicating a plateau: among this sample, consumption of fish sauce containing more than 2 g/L thiamin did not confer higher eTDP. Indeed, dietary consumption data from the weighed fish sauce records highlight that women in the high concentration group could have received up to 626 mg thiamin in one day from fish sauce alone (**Table 4-3**). Healthy adults have an estimated total body thiamin content of 25-30 mg (13). At high doses only a small portion of thiamin is absorbed (23), and of that, little

is retained, with high concentrations of thiamin appearing in urine shortly after administration (21). For instance, a single oral dose of thiamin higher than approximately 2.5 to 5 mg has shown to go largely unabsorbed in healthy adults (20). However, rapid metabolism and turnover of this vitamin, with a biological half-life of 9-18 days (24), necessitates routine dietary intake (13). However, given the average fish sauce intake of 16 mL/d among women, a fortification level of 0.09 g/L would have provided 1.4 mg/d thiamin; at concentrations of 2 and 8 g/L, 32 and 128 mg/d, respectively, were consumed. While there is no UL for thiamin and daily over-the-counter supplements can contain 50 mg thiamin (18) or more, the lowest effective concentration of thiamin is likely well under 2 g/L and should be determined to limit excess intake and keep costs low for consumers (87).

Among women in the HC group, the change in eTDP between baseline and endline was influenced by women's initial thiamin status. HC group women in the lowest baseline eTDP tertile had a significantly larger improvement in eTDP (mean change between baseline and endline of 88 nM) compared to women in the highest eTDP tertile at baseline (mean change of 34 nM). Although this trend was not found among women in the LC group, these results suggest that with the same intervention those women starting off with lower thiamin status have higher potential to benefit and will likely show greater improvement than those who are adequate to begin with.

Most Cambodian producers sell three types of fish sauce: high quality, with high protein content, dark colour, and rich fish flavours; medium quality, which is a slightly watered

down version of high quality; and low quality, which is more dilute, lighter in colour, and contains artificial colours and flavours. We fortified medium quality fish sauce (market value ~US$0.85 per 750 mL bottle). Before the study, approximately half of women made fish sauce at home (*n*=148, 54%), and based on self-reported costs, those who did purchase at market likely selected low quality fish sauce (mean ± SD, 2,056 ± 568 riel, or ~US$0.50 ± 0.15 per 750 mL bottle). Therefore, additional research is required to determine the effectiveness of thiamin-fortified fish sauce, investigating both a wider quality range of fish sauces, and requiring participants to purchase sauce.

Adherence to study fish sauce was high, and fortnightly check-ins showed limited fish sauce sharing outside the household: only 7 women reported sharing fish sauce, and each only once over the six month study. Fish sauce was distributed for free for *ad libitum* consumption, so intake was likely higher than usual, potentially replacing other condiments such as soy sauce or salt.

This study had several strengths: we recruited women from randomly selected villages not involved in other nutrition interventions, had frequent fortnightly follow-ups with participants, measured detailed fish sauce consumption in a subset of households with the weighed fish sauce record, and had a control group, which was very important as we saw an increase in eTDP across all three treatment groups over the 6 month study. The latter may be attributed to seasonal economic status and/or food availability: baseline data collection took place in October, but wet-season rice, the major economic activity and a main driver of food security for rural Cambodians, is harvested in December/January (3).

With this, it would be of interest to follow-up over one year to identify the true seasonal differences in thiamin intake and biochemical status.

Limitations of this study include restriction to one rural province in Cambodia, a higher than expected attrition rate, and a lack of dietary intake data beyond fish sauce consumption. Future research should aim to determine usual fish sauce intake throughout the year outside of a controlled study environment to obtain better consumption data from which to base the thiamin fortification level, and rather than distribute fish sauce for free, should make it available at market for women to purchase. In addition, research to determine the usual intake of thiamin would be beneficial in optimizing the fortification dose; while women and children consuming fish sauce fortified at 2 g/L had significantly higher eTDP than those in the control group, the optimal fortification dose may be lower than 2 g/L. More research is required to optimize the dose to avoid unnecessary excess intake and lower production costs.

Another major limitation of this research is a lack of interpretive criteria for sufficient thiamin status using eTDP. Appropriate deficiency cut-offs are unclear as they vary widely: >70 nM (54), >140 nM (55), and >148 nM (56). Therefore, cut-offs were not employed in this study, making it more difficult to quantify the fortification level required for adequate maternal status to prevent infantile beriberi. Curiously, women's baseline eTDP was higher than previously reported: 167 ± 52 nM (*n*=276), compared to 149 ± 36 (*n*=121 women aged 20-45 in Prey Veng; see **Table 2-1**). This difference may be attributable to seasonal variation (baseline data was collected in April in this study,

while the previous data was collected in January), or differences in socioeconomic status of the women enrolled (women in this study were wealthier and better educated, see **Table 2-1** and **Table 4-1**), but this cannot be confirmed.

Fish sauce is an efficacious means of improving thiamin intake, and therefore has potential to be a simple and sustainable vehicle for other micronutrients as well. Given that women may make their own fish sauce, presumably especially those who are very poor and can use fish caught freely from rice paddies in the rainy season, salt fortification (83), a major ingredient in fish sauce that is already fortified with iodine (83), should also be explored as a thiamin fortification vehicle in tandem with fish sauce to reach those at highest risk of inadequate thiamin intake.

Chapter 5: Perinatal consumption of thiamin-fortified fish sauce in rural Cambodia: a randomized controlled efficacy trial

5.1 Summary

Background: Infantile beriberi, a fatal disease caused by thiamin deficiency, remains a public health concern in Cambodia and regions where B-vitamin poor, polished white rice is a staple food. Low maternal thiamin intake limits breast milk thiamin content, putting breastfed infants at risk of beriberi. We fortified fish sauce, a popular Cambodian condiment, to increase maternal dietary thiamin intake.

Objective: To determine whether maternal consumption of thiamin-fortified fish sauce could improve the erythrocyte thiamin diphosphate concentration (eTDP) of mothers and their breastfed infants, and breast milk thiamin concentrations, compared to mothers consuming a control fish sauce.

Methods: In this community-based, double-blind randomized controlled efficacy trial, 90 pregnant women (18-45 y; 23 ± 7 wk gestation at enrolment) were recruited in Prey Veng province, Cambodia. Women were randomized to one of three treatment groups (n=30 per group) for *ad libitum* consumption of fish sauce for 6 months: control, low (LC, 2 g/L) or high concentration (HC, 8 g/L) thiamin-fortified fish sauce. Maternal blood was collected at baseline. Maternal blood, breast milk, and infant blood were collected at endline (t=6 mo). eTDP and breast milk thiamin were measured using HPLC-FLD.

Results: Baseline-adjusted endline eTDP (estimated marginal mean, 95% CI) were significantly higher among mothers in the LC (276; 246, 306 nM) and HC (238; 207, 268 nM) groups compared to control (194; 163, 224 nM; P<0.05); LC and HC did not differ (P=0.08). Total breast milk thiamin concentrations were significantly higher among

women in both LC (211; 187, 236 μg/L) and HC (180; 152, 209 μg/L) groups compared to control (136; 110, 162 μg/L; $P<0.05$). Infants of HC mothers had significantly higher eTDP (257; 215, 298 nM; $P<0.05$) compared to LC (205; 175, 235 nM) and control (181; 153, 210 nM).

Conclusions: Perinatal consumption of thiamin-fortified fish sauce for 6 months improved eTDP and breast milk thiamin concentrations among pregnant and lactating women in rural Cambodia, and in turn improved eTDP of their breastfed infants. Regular consumption of thiamin-fortified fish sauce has the potential to improve maternal thiamin status, and in turn prevent infantile beriberi in this population.

5.2 Introduction

Infantile beriberi is caused by thiamin (vitamin B_1) deficiency (13) and typically presents among breastfed infants (57) around 3 months of age (68) with a persistent hoarse cry, vomiting, anorexia, generalized edema, oliguria (19), convulsions, and signs of heart failure (liver enlargement, rapid breathing, and rapid heart rate) (11). Without rapid thiamin administration infants can die within hours (68). Mothers with poor dietary thiamin intake produce breast milk low in thiamin, putting their infants at risk of developing thiamin deficiency and infantile beriberi (57). During infancy, a period of rapid growth and development, thiamin needs are high relative to body size placing infants at risk of beriberi (13,67,78) while mothers remain asymptomatic (13). Umbilical cord blood of thiamin-replete mothers has up to three times higher thiamin concentrations than maternal blood at birth (28) due to preferential thiamin sequestration to the fetus

during the third trimester (27). Thus, low maternal thiamin intake throughout pregnancy can impose further increased risk of developing infantile beriberi (57).

Infantile beriberi-related mortality was common among breastfed infants of Karen refugees living in camps on the Thai-Burmese border in the 1980s (29,68,70). While addressed there through supplementation (68), poor thiamin status likely remains a public health concern in Cambodia due to a lack of dietary diversity (1). Thiamin is found in high concentrations in foods that are either not typically consumed (legumes and whole grains, for example, brown rice), or which are costly (pork). Finally, food balance sheet analysis estimate that approximately 60% of daily calories (8) come from non-parboiled (44), polished white rice, a very poor source of thiamin (13). We recently reported significantly lower erythrocyte thiamin diphosphate concentrations (eTDP), an indicator of thiamin status, among a representative sample of non-pregnant, non-lactating Cambodian women of childbearing age living in rural Prey Veng province compared to healthy, purportedly vitamin-replete Canadian peers (93,94). With this, pregnant and lactating women would likely also have lower eTDP than the Canadian women sampled since thiamin requirements increase during these life stages (18,31).

Supplementation of thiamin deficient lactating women has been shown to improve breast milk thiamin concentrations in the Karen refugee camps (68,72), rural Cambodia (73), the Gambia (74), and India (75); however supplementation is a targeted, resource-intensive intervention that relies heavily on individual compliance. With a combination of diverse diets and thiamin fortification/enrichment of white wheat flour (36,37,64),

infantile beriberi is virtually non-existent in the West. An estimated 90% of Cambodians consume fish sauce (85), and this condiment is already a fortification vehicle for iron (84–86). As such, thiamin fortification of fish sauce could be a sustainable, low-cost, and passive intervention (87–89) to improve the dietary thiamin intake of pregnant and lactating women and, in turn, their breastfed infants.

The aim of this study was to determine whether consumption of thiamin-fortified fish sauce over six months during pregnancy and early lactation yielded higher eTDP and breast milk thiamin concentrations among rural Cambodian women compared to those consuming a control fish sauce containing no thiamin. A second aim was to determine whether eTDP differed between infants of mothers consuming thiamin-fortified fish sauce compared to infants of mothers consuming control fish sauce (no detectable thiamin).

5.3 Methods

5.3.1 Study design

This was a community-based, double-blind, randomized controlled efficacy trial conducted in two groups of women concurrently: 90 pregnant, and 270 non-pregnant women. We report here on the 90 pregnant women recruited through convenience sampling from Prey Veng province, Cambodia. Eligibility criteria were as follows: 18-45 y and 3-8 mo pregnant with a singleton fetus (self-report); the female head of their household; planned to exclusively breastfeed their infant for 6 mo; no prior history of preeclampsia, pre-term delivery, or birth defects; not involved in other non-governmental

nutrition programs; not consuming thiamin-containing dietary supplements (not standard of care in Cambodia (81)); agreement to exclusively consume the study fish sauce in their household; and no plans to leave their village (e.g. for seasonal work) for the duration of the study (6 mo). See **Figure 5-1** for participant recruitment, flow, and follow-up. Women provided written informed consent to participate. Ethical approval was obtained from the Cambodian National Ethics Committee for Health Research (0245NECHR) and the University of British Columbia – Children's and Women's Health Centre of British Columbia Research Ethics Board in Canada (CQ14-0204/H14-01654). Clinicaltrials.gov Identifier: NCT02221063.

5.3.2 Intervention: fortified fish sauce

Study fish sauce was produced by Leang Leng Enterprises (Phnom Penh, Cambodia) and received Cambodian Ministry of Health Certification for Hygienic Food Production. Fish sauce was pasteurized for 90-120 min at 100°C, cooled to room temperature, then fortified as follows: low concentration thiamin (LC, 2 g/L thiamin hydrochloride (THCL; ≥ 98% purity), Huazhong Pharmaceutical Co., Ltd, China); high concentration thiamin (HC, 8 g/L THCl); and control, which contained no detectable thiamin. Thiamin fortification dose in fish sauce is discussed in *3.3.1*. All fish sauces were also fortified with iron as ferric sodium ethylenediaminetetraacetate (2.8 g/L Ferrazone®, Akzo Nobel Functional Chemicals B.V., The Netherlands) as per Cambodian Ministry of Planning guidelines (86).

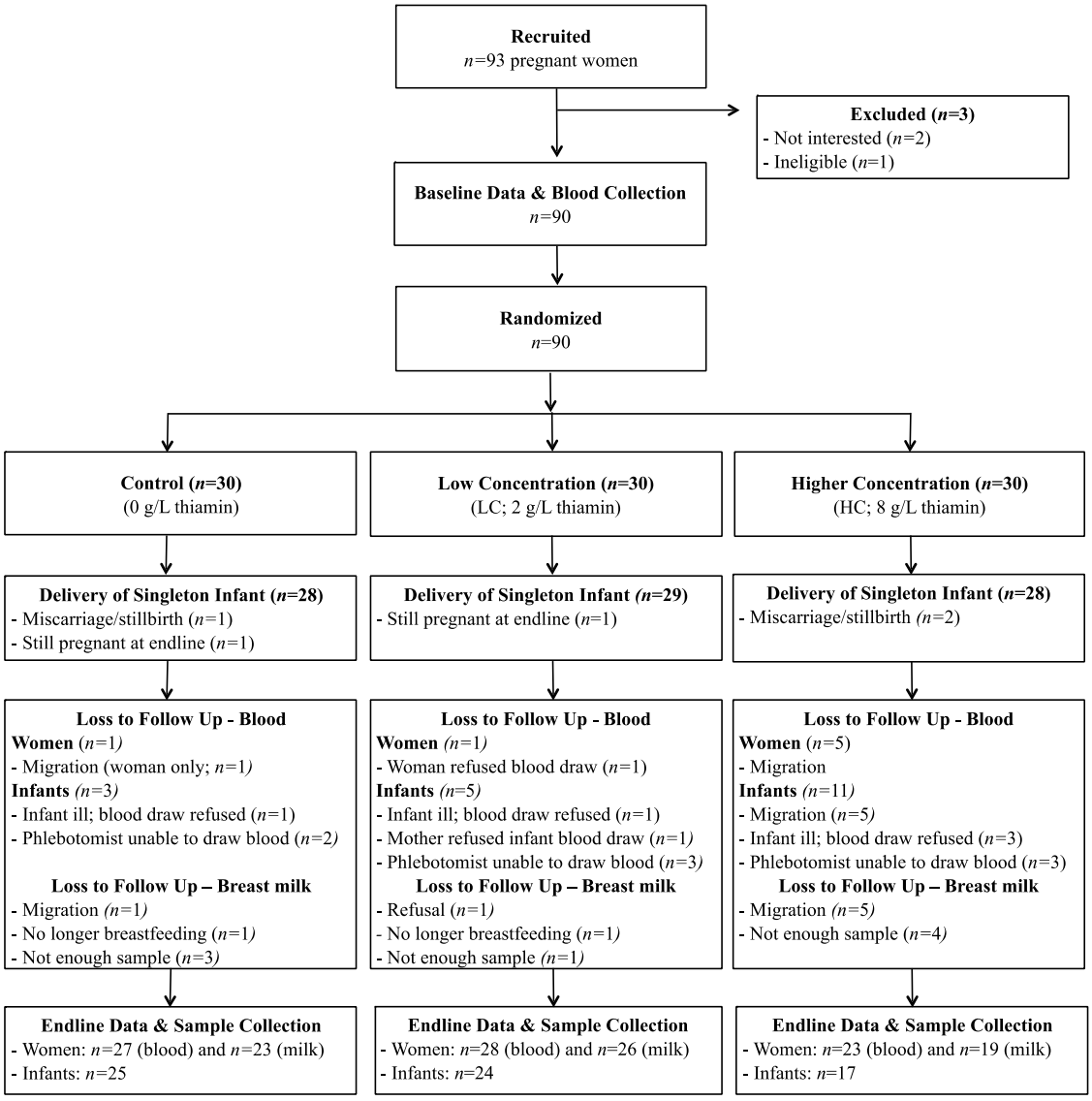


Figure 5-1: Participant flow and follow-up for pregnant and lactating Cambodian women (18-45 y) and their newborn breastfed infants.

Fish sauce packaging was identical among the three groups except for a unique serial number stamp on each bottle, and different coloured caps for different study arms intended to prevent confusion amongst field staff and participants. Green, orange, and purple were selected for bottle caps after consultation with local women highlighted these as pleasant yet culturally and politically neutral colours (*n*=60 women aged 18-45 y from focus group discussions in 12 villages within 3 communes in Prey Veng, Cambodia; see semi-structured guide in Appendix C). The blinding code was known to Leang Leng Enterprises, and was stored in a sealed envelope held by the Principal Investigator in case of emergency. Sensory evaluation using the triangle test (110) indicated that Cambodian women (*n*=90) were unable to discern the three study fish sauces.

5.3.3 Randomization

Using a pre-determined master list of individual randomized ID numbers, field staff assigned IDs sequentially at enrollment. Women received fish sauce after their baseline study visit, and fortnightly thereafter during household visits by field staff. Since Cambodian families eat from a common pot, participants and their entire household were instructed to consume the study fish sauce *ad libitum*, as they normally would, throughout the six-month study. At 1 mo (November 2014), study participants attended a nutrition education workshop in their village to learn the signs, treatment, and prevention of infantile thiamin deficiency and beriberi, as well as the Cambodian Ministry of Health infant and young child feeding curriculum (81). Participant's family members (husbands, sisters, mothers, mothers-in-law etc.) were invited to attend.

5.3.4 Data and biological sample collection

At baseline (October 6-17, 2014) and endline *(t*=6 mo, April 22-29, 2015) demographic information was collected using an interviewer-administered questionnaire in women's homes (see questionnaire in Appendix F). Participants gave birth during the study; field staff visited each participant within 72 hours of birth to measure the infant's length and weight using a length board and calibrated weight scale, respectively (123).

The morning following data collection, non-fasting venous blood samples were collected into evacuated EDTA-coated tubes (Vacutainer, Becton Dickinson, Mississauga, ON) from women and their infants (endline only) at a central village location. Blood samples were then transported on ice to the National Institute for Public Health (NIPH) laboratories in Phnom Penh within 5 h of collection. Blood samples were centrifuged at 3000 rpm for 15 min at 4°C, plasma and buffy coat were removed, and erythrocytes washed three times with phosphate buffered saline (Amresco, Solon, OH) before storage at -80°C.

Breast milk samples were collected using a battery-powered single breast pump (Swing Breast pump, Medela, Mississauga, ON). One full breast expression was collected from the breast that women self-identified as being more 'full' (the breast not most recently fed from). Two women chose to manually hand-express milk rather than use the breast pump. Breast milk was transported along with the blood samples to NIPH daily on ice. Total milk volume was recorded, then milk was mixed well, aliquoted into amber cryovials, and stored at -80°C. All blood and breast milk samples were batch shipped on dry ice to the University of British Columbia (UBC) in Vancouver, Canada in June 2015.

5.3.5 Erythrocyte thiamin diphosphate analysis

eTDP was measured at UBC using reverse-phase high performance liquid chromatography with a fluorescence detector (HPLC-FLD) according to Lu & Frank (51), with modifications. Briefly, 500 µL of 10% wt/vol trichloroacetic acid in deionized water was added to a mixture of 250 µL previously frozen packed erythrocytes and 250 µL deionized water. Samples were vigorously vortex mixed, placed on ice for 15 min, and then centifuged (13000 *g*, 10 min). An aliquot of supernatant (500 µL) was washed twice with 750 µL of water saturated methyl-tert-butyl ether. From the aqueous layer, a 150 µL aliquot was then transferred to a 96 well plate. HPLC analysis was performed using an Agilent 1260 Infinity system with a Poroshell 120 EC-C18 column (3.0 x 50 mm with 2.7 µm; Agilent Technologies, Mississauga, ON) at 25°C with the detector set at an excitation wavelength 375 nm and emission wavelength 435 nm. Mobile phase A consisted of 25 mM sodium phosphate (pH 7.0) and methanol (90:10 vol/vol), while mobile phase B consisted of 25 mM sodium phosphate (pH 7.0) and methanol (30:70 vol/vol). Prior to injection, online sample derivatization (methanol, sample, and 1.2 mM potassium ferricyanide in 15% wt/vol sodium hydroxide) was performed by automated injector programming. Quantitation of eTDP was based on peak area and external standardization using TDP calibration solutions (range ~20-800 nM; Sigma-Aldrich, Oakville, ON; recoveries of low (20 nM) and high (800 nM) standards in deionized water were 102.5% and 93.2%, respectively). Quality controls were conducted on each run using pooled erythrocytes from ten healthy Canadian adults (inter-run CVs <9%, n=17).

5.3.6 Breast milk thiamin analysis

Free thiamin, thiamin monophosphate (TMP), and thiamin diphosphate (TDP) in breast milk were analyzed at the USDA/ARS Western Human Nutrition Research Centre, University of California, Davis using HPLC-FLD and pre-column derivatization of the analytes to their thiochrome esters. 12 µL of perchloric acid ($HClO_4$, 70%, Sigma Aldrich, St. Louis, MO) was added to 100 µL breast milk for protein precipitation. After vortexing for 1 min the samples were centrifuged at 4°C for 10 min at 14000 rpm, then 75 µL of the supernatant was transferred into a fresh 1.5 mL centrifuge tube. The thiamin vitamers were derivatized by adding 27 µL of an aqueous solution of 12 mM potassium ferricyanide ($K_3[Fe(CN)_6]$) in 3.35 N sodium hydroxide (NaOH). After briefly mixing, the reaction was quenched with 24 µL 1M phosphoric acid (H_3PO_4) to neutral pH. After filtration, 30 µL of the sample was analyzed via an Agilent 1200 series HPLC-FLD using a Phenomenex Kinetex C18 column (100 Å, 150 x 4.6 mm, 5 µm) protected by a Phenomenex SecurityGuard C18 pre-column (4 x 30 mm; Torrance, CA). A solvent gradient of 0.15 M dipotassium hydrogen phosphate (K_2HPO_4; mobile phase A) and methanol (mobile phase B) was employed as follows: 0 min: 85% A, 3 min: 80% A, 6 min: 50% A, 6.5-8min: 85% A at a flow rate of 1.4 mL/min. Excitation and emission wavelengths for detection were set to 367 and 435 nm, respectively. A pooled breast milk sample with previously established thiamin concentrations was used as an internal control. This control was measured four times; CVs for thiamin, TMP, and TDP were 2%, 2%, and 5%, respectively.

5.3.7 Statistical analysis

We estimated that a sample size of n=30 mothers per group would be sufficient to detect a 30% difference in maternal eTDP between fortified and control groups at endline assuming a

minimum baseline of 38 nM (93), SD of 18 nM (122), 80% power, and alpha=0.05 using a 2-sided test. Demographic characteristics were summarized as mean ± SD or *n* (%). Maternal eTDP analyses were conducted using both intent-to-treat (ITT) and as-treated analyses. In ITT, baseline eTDP values were carried forward when endline data were missing (all analyses refer to ITT unless otherwise stated); in as-treated, only participants with complete data were included in analysis.

General linear models (GLM) were used to assess differences between fortified groups (LC and HC) compared to the control group (reference) for the following: maternal endline eTDP (adjusted for baseline eTDP), infant eTDP, breast milk thiamin concentrations, infant age and lactation duration, and fish sauce consumption. Post-hoc analysis with least significant difference (LSD) adjustment for multiple comparisons was used to assess differences between the three treatment groups (LC, HC, and control). Estimated marginal means (95% CI) are reported for GLM. All analyses were performed with SPSS for Macintosh version 23.0 (IBM Corp., Armonk, NY), with a significance level of $P<0.05$.

5.4 Results

Participant flow and follow-up can be found in **Figure 5-1**. Ninety-three pregnant women in Prey Veng, Cambodia were screened; 90 met eligibility criteria, agreed to participate, and were randomized to the three study arms, $n=30$ per group. Five participants were excluded from analyses: 3 due to stillbirth or miscarriage, and 2 who had not yet delivered by endline data collection. Retention in the three groups was $n=27$, 28, and 23 for control, LC, and HC, respectively.

Baseline demographic characteristics of participants can be found in **Table 5-1**. Mean ± SD age of women at enrollment was 26 ± 5 y, the majority of women were in their second trimester (mean gestation, 23 ± 7 wk), and approximately half of women were pregnant with their first child. Most women attended 5 antenatal care visits throughout pregnancy, and delivered at their local health centre (**Table 5-2**). Mean ± SD birth length and weight was 49 ± 2 cm and 3.1 ± 0.6 kg, respectively, and only 5 infants had low birth weight (<2.5 kg). Household fish sauce consumption was similar across all three treatment groups: households in LC, HC, and control groups consumed 15 (13, 16), 13 (11, 14), and 16 (14, 17) 750 mL bottles, respectively, over the 6 mo study (P=0.07).

Table 5-1: Baseline demographic characteristics and eTDP of women (18-45 y) in the pregnant and lactating cohort[1]

	Control ***n*=28**	**Low Concentration** ***n*=29**	**High Concentration** ***n*=28**
Age, *y*	27 ± 5	26 ± 5	25 ± 5
# weeks pregnant, *wk*	23 ± 8	22 ± 7	25 ± 8
Parity			
Primipara	13 (46)	16 (55)	14 (50)
Multipara	15 (54)	13 (45)	14 (50)
Number in household	5 ± 1	5 ± 2	5 ± 1
Education			
None	2 (7)	3 (10)	1 (~4)
Primary	11 (39)	15 (52)	12 (43)
Lower Secondary	12 (43)	8 (28)	14 (50)
Upper Secondary	2 (7)	3 (10)	1 (~4)
Higher Education	1 (4)	-	-
Annual household income, *US$*[2]	1,625 ± 1,156	1,440 ± 1,233	1,388 ± 1,301
Bottom 20%	2 (7)	3 (10)	4 (14)
Middle 60%	11 (39)	15 (52)	11 (39)
Top 20%	15 (54)	11 (38)	13 (47)
Erythrocyte thiamin diphosphate, *nM*	152 ± 44	175 ± 62	179 ± 63

[1] mean ± SD or *n* (%). eTDP, erythrocyte thiamin diphosphate concentration (eTDP; nM)
[2] households were classified using 2011 income quintiles from Prey Veng province, Cambodia (99)

Table 5-2: Antenatal care and delivery outcomes of rural Cambodian women (18-45 y) in the pregnant and lactating cohort, and characteristics of their newborn infants[1]

	Control	**Low Concentration**	**High Concentration**
	n=27	***n=28***	***n=23***
Antenatal			
Antenatal care visits	5 ± 2	5 ± 2	5 ± 3
Iron folic acid tablets consumed	85 ± 19	78 ± 25	85 ± 23
Deworming treatment	23 (85)	20 (71)	20 (87)
Delivery/Postpartum			
Delivery location			
Local Health Centre	13 (48)	17 (61)	9 (39)
District Hospital	1 (4)	1 (~4)	6 (26)
Provincial Town Hospital	3 (11)	1 (~4)	2 (9)
Private Clinic or Hospital	10 (37)	8 (29)	6 (26)
Other: garment factory	-	1 (~4)	-
Infant characteristics			
Female	14 (52)	13 (46)	9 (39)
Birth weight, *kg*[2]	3.1 ± 0.5	3.0 ± 0.4	3.1 ± 0.9
Low birth weight (<2.5kg)[2]	3 (11)	1 (4)	1 (4)
Birth length, *cm*[2]	49 ± 2	49 ± 2	49 ± 3
Age at endline, *wk*	16 ± 8	17 ± 7	14 ± 8

[1] mean ± SD or *n* (%)
[2] LC, *n*=27

Maternal endline eTDP can be found in **Table 5-3**. Baseline-adjusted endline eTDP (estimated marginal mean; 95% CI) was significantly higher among women in LC (276; 246, 306 nM) and HC (238; 207, 268 nM) groups compared to women in the control group (194; 163, 224 nM; $P<0.05$); women in LC and HC groups did not differ ($P=0.08$). As-treated analysis did not change the findings markedly (see **Table 5-3**). Infant eTDP at endline is also found in **Table 5-3**. Infants of mothers in the HC group had significantly higher eTDP (257; 215, 298 nM; $P<0.05$) compared to mothers in the LC (205; 175, 235 nM) and control groups (181; 153, 210 nM).

Table 5-3: Endline (6 mo) eTDP of mothers and their breastfed infants in the pregnant and lactating cohort[1]

	β	SE	*P value*	*n*	Estimated Marginal Means (95% CI)
Mothers					
Intent-to-Treat[2]					
Control	(Ref)	-	-	28	194 (163, 224)[a]
Low concentration	82	22	<0.001	29	276 (246, 306)[b]
High concentration	44	22	0.048	28	238 (207, 268)[b]
As Treated[3]					
Control	(Ref)	-	-	27	195 (163, 227)[a]
Low concentration	87	22	<0.001	28	282 (252, 312)[b]
High concentration	61	23	0.011	23	256 (222, 290)[b]
Infants					
Control	(Ref)	-	-	25	181 (153, 210)[a]
Low concentration	24	1	0.263	24	205 (175, 235)[a]
High concentration	75	3	0.002	17	257 (215, 298)[b]

[1] General linear models were used to assess differences in eTDP between fortified groups (LC and HC) and control group (reference). Maternal model was adjusted for baseline eTDP. Post-hoc analysis (with LSD adjustment for multiple comparisons) assessed differences between LC, HC, and control groups; values that do not share a common superscript differ significantly, $P<0.05$. eTDP, erythrocyte thiamin diphosphate concentration (eTDP, nM)

[2] In intent-to-treat analysis, baseline values were carried forward for missing endline values.

[3] In as-treated analysis, $n=7$ women were excluded from analyses due to attrition and blood draw refusal.

Concentrations of the three thiamin vitamers found in human milk, thiamin, TMP, and TDP, as well as total thiamin (calculated as the amount of thiamin from TMP, TDP, and thiamin), can be found in **Table 5-4**. TMP was the most abundant vitamer in these breast milk samples. Breast milk TMP was significantly higher among women in the LC group (166; 146, 187 μg/L) compared to the control group (133; 111, 154 μg/L; P=0.03). Total breast milk thiamin was significantly higher among women in both LC (211; 187, 236 μg/L) and HC groups (180; 152, 209 μg/L) compared to the control group (136; 110, 162 μg/L; P<0.05); LC and HC did not differ (P=0.10). Thiamin concentration followed the same pattern: women in LC and HC groups produced breast milk with significantly higher thiamin than those in the control group (P<0.05). TDP, which made up <5% of total thiamin in breast milk, did not differ between groups (P=0.28).

Table 5-4: Thiamin concentrations of mature breast milk, and estimated daily total thiamin intake of infants fed this milk, from rural Cambodian mothers (18-45 y) in the pregnant and lactating cohort[1]

	Control *n*=23	**Low Concentration *n*=26**	**High Concentration *n*=19**
Thiamin			
µg/L	18 (3, 33)[a]	63 (49, 77)[b]	54 (38, 71)[b]
nM	66 (10, 123)[a]	237 (184, 290)[b]	204 (142, 266)[b]
Thiamin monophosphate			
µg/L	133 (111, 154)[a]	166 (146, 187)[b]	140 (116, 163)[ab]
nM	385 (232, 448)[a]	483 (424, 542)[b]	406 (337, 475)[ab]
Thiamin diphosphate			
µg/L	4 (2, 6)[a]	5 (3, 7)[a]	6 (4, 9)[a]
nM	9 (4, 14)[a]	12 (7, 17)[a]	15 (9, 20)[a]
Total thiamin[2]			
µg/L	136 (110, 162)[a]	211 (187, 236)[b]	180 (152, 209)[b]
nM	512 (414, 609)[a]	797 (705, 888)[b]	680 (572, 787)[b]
Estimated Infant Intake (µg/d)[3]	104 (83, 124)[a]	165 (145, 185)[b]	138 (115, 161)[b]

[1] General linear models were used to assess differences between fortified groups (LC and HC) and the control group (reference). Post-hoc analysis (with LSD adjustment for multiple comparisons) assessed differences between LC, HC, and control groups; values in rows that do not share a common superscript differ significantly, $P<0.05$. Results expressed as estimated marginal means (95% CI).

[2] Total thiamin calculated as amount of thiamin from thiamin monophosphate, thiamin diphosphate, and free thiamin

[3] Estimated infant intake (µg thiamin/d) calculated based on daily breast milk consumption of exclusively breastfed infants in developing countries: 0-2 mo, 714 mL/d; 2-5 mo, 784 mL/d; 6-8 mo, 776 mL/d (59)

5.5 Discussion

Perinatal consumption of thiamin-fortified fish sauce for six months yields higher eTDP among pregnant and lactating women and their breastfed infants in rural Cambodia compared to mothers consuming a control fish sauce without thiamin. Breast milk total thiamin concentrations were significantly higher among women consuming fortified fish sauce compared to those in the control group.

It has been established that maternal thiamin supplementation of deficient mothers increases breast milk thiamin concentrations (57). Prentice and colleagues reported a significant increase in breast milk thiamin concentration from 160 to 220 μg/L (P<0.001) among Gambian women consuming a supplemental food containing 1.36 mg thiamin daily for one year (74). Similarly, breast milk thiamin of 5 nutritionally inadequate Indian women increased from 109 to 268 μg/L after daily micronutrient supplementation of increasing doses (0.2 – 20 mg/d) over 8 months (75).

While no infants in this study showed clinical symptoms of infantile beriberi, a lack of clear biomarker cut-offs hinders assessment of biochemical thiamin adequacy. The Institute of Medicine used observed thiamin concentrations of 210 μg/L in milk produced by well-nourished mothers (32–34) to set the adequate intake (AI) for infants aged 0-6 mo at 200 μg thiamin/day (18). Using estimated daily breast milk intakes for exclusively breastfed infants in developing countries (59) we predicted daily thiamin intake of infants in our study (see **Table 5-4**). Only 9 infants (LC, n=7, HC, n=2) would have consumed ≥200 μg/d. Curiously, a recent report of thiamin concentrations in mature milk (≥2 weeks) collected from women globally (including the United States) and no infants consuming this milk would have consumed the AI (18,58). However, a limitation of this source is that breast milk thiamin rather than total thiamin (thiamin + TMP + TDP) or TMP (the most abundant vitamer in breast milk), is reported. However, the findings echo a recent study in Malawi reporting that only 50% of anti-retroviral-treated mothers living with HIV who had been consuming thiamin-containing dietary supplements for 6 months produced breast milk (expressed as breast milk total thiamin) that would meet the infant thiamin AI (124).

The report of breast milk thiamin concentrations globally also highlighted wide variation in breast milk thiamin concentrations by region: India, 11 μg/L (*n*=24), Malawi, 21 μg/L (*n*=18), China, 31 μg/L (*n*=5), United States, 37 μg/L (*n*=28), and Cameroon, 116 μg/L (*n*=5) (58). These breast milk thiamin concentrations (apart from Cameroon) align relatively well with those of women in the control group (18 μg/L, *n*=23). Our breast milk thiamin of 63 and 54 μg/L for LC (*n*=26) and HC (*n*=19) groups, respectively, are higher than values in the United States, which may be due to supplement consumption, but unfortunately this and other dietary intake data were not reported (58).

We recognize that AIs are developed when there is not sufficient evidence available to establish an estimated average requirement and recommended dietary allowance, and are expected to meet or exceed the needs of individuals in that age group (18). As such, thiamin intakes lower than the AI of 200 μg/d could be sufficient and may not impose risk of infantile beriberi. Actually, the AI was rounded up from 160 μg/d (18), but even when using a cut-off of 160 μg/d, only 17 infants (LC, *n*=13; HC, *n*=4) would have had sufficient thiamin intake. The current infant thiamin AI was determined from data from only 24 American women in 1980 (33,34). Improvements in analytical techniques for quantification of thiamin in biological samples during the past 35 years (35) may explain some of the discrepancy between the AI cut-off and recently published reference values; as such, thiamin AIs for infants aged 0 – 6 mo should be re-visited.

The amount of thiamin in breast milk is known to increase with lactation duration (58), therefore the age of the child likely influences breast milk thiamin concentration. Infant age did not differ

by treatment group (P=0.38) and total thiamin in breast milk was not correlated with infant age in our study (P=0.07), but this may be attributed to the small sample size.

While eTDP was significantly higher among women consuming fortified fish sauce compared to control, there was no significant difference between women in the LC and HC groups (P=0.08). Total breast milk thiamin concentration also did not differ between LC and HC groups (P=0.10). This suggests that consumption of fish sauce fortified at, or even below, 2 g/L is sufficient for maternal thiamin adequacy. However, infant eTDP was significantly higher among HC compared to LC (P=0.03). Since LC and HC breast milk total thiamin concentrations did not differ, and infant age or lactation status was similar between groups (P=0.36), this finding may highlight the importance of maternal thiamin adequacy in late pregnancy (13,27,57) as HC infants may have built up thiamin stores *in utero*.

This study had several strengths, including both antenatal and postpartum consumption of fish sauce, frequent fortnightly follow-ups with participants, biological sample collection from mothers (both blood and breast milk) and their breastfed infants, and a control group, which was shrewd as we saw an increase in maternal eTDP between baseline and endline. Limitations include a lack of dietary intake data and representation from only one Cambodian province. The women in this study were relatively well-off, with 44% in the top wealth quintile for Prey Veng province (99). Women participating in other non-governmental nutrition programs were ineligible to participate in this study to avoid potential contamination, and our convenience sample was likely recruited from main roads where paid labour is more easily accessible compared to more remote households. Future research should target poor households, where

infantile beriberi is presumably a larger issue. While we collected a full breast expression from the breast mothers self-reported as not most recently emptied, we did not have information on the last feed, and this one expression is not necessarily representative of usual milk. Finally, there is a lack of interpretive criteria for normal or healthy eTDP for women, as cut-offs in the literature vary widely: >70 nM (54), >140 nM (55), and >148 nM (56). A recent study in Prey Veng, Cambodia reported no significant difference in blood thiamin concentrations between mothers of infants with and without beriberi (11). Unexpectedly, baseline eTDP found in this study, 169 ± 58 nM (HC, LC, and control women, n=85) were similar to values reported among a convenience sample of Vancouver women, 179 ± 37 nM (n=47, 20-45 y; see **Table 2-1**). These unexpected values, alongside the range in cut-offs in the literature highlight the need for more research to develop clinically meaningful cut-offs for thiamin deficiency.

Adequate maternal thiamin intake throughout pregnancy and lactation allows for thiamin sequestration *in utero* (27) and production of thiamin-replete breast milk (18,57), preventing infantile thiamin deficiency and beriberi among breastfed infants. Here we showed that 6 month perinatal consumption of thiamin-fortified fish sauce, a condiment consumed by the majority of Cambodians (85), is an efficacious means of increasing maternal eTDP and breast milk thiamin, and in turn, infant eTDP. Therefore, thiamin-fortified fish sauce has the potential to prevent infantile beriberi and its related infant mortality in Cambodia and the region among women consuming commercially produced (rather than homemade) fish sauce. This intervention is facilitated by existing fortification infrastructure within factories as fish sauce has already been successfully fortified with iron in Cambodia and Vietnam (84–86,102,103). As such, fish sauce could be a simple and sustainable vehicle for other micronutrient fortification as well. Further,

fortification is a population-wide intervention, so there is potential for all consumers of thiamin-fortified fish sauce to improve thiamin intake,, potentially preventing beriberi outbreaks (95) and improving thiamin status of women (93,94) before conception.

5.6 Conclusions

Perinatal consumption of thiamin-fortified fish sauce for six months was an efficacious means of improving eTDP and breast milk thiamin concentrations among pregnant and lactating women in rural Cambodia, and in turn, eTDP in their breastfed infants. More research is needed before this intervention can be scaled-up, but this research highlights the potential for thiamin-fortified fish sauce to improve thiamin intake and status, which in turn may provide a sustainable means of preventing infantile beriberi in this region.

Chapter 6: Conclusions, discussion, and future research

6.1 Introduction

Infantile beriberi remains a cause of infant mortality in Cambodia and throughout Southeast Asia despite its relatively easy treatment and prevention with thiamin. After identifying that Cambodian women of childbearing age had lower biochemical thiamin status than purportedly thiamin-replete Canadian women in Vancouver, the overall objective of my doctoral research was to identify and test the efficacy of an inexpensive, sustainable, and culturally-appropriate intervention to improve thiamin intake and status of these women with the long term goal of eradicating infantile beriberi in Cambodia. This research has contributed to the body of knowledge on thiamin deficiency, and, through close collaboration with nutrition stakeholders in-country, including the Cambodian Ministry of Health and Ministry of Planning (National Sub Committee for Food Fortification), has brought the issue of thiamin deficiency and infantile beriberi to the attention of public health nutrition stakeholders, health practitioners, and policy makers in Cambodia.

6.2 Discussion of key findings

6.2.1 Efficacy of thiamin-fortified fish sauce

Using an iterative approach, after developing a stable and well-accepted thiamin-fortified fish sauce, I aimed to determine whether six-month *ad libitum* consumption of thiamin-fortified fish sauce could improve eTDP compared to a control sauce (containing no thiamin) among rural Cambodian women and their children. In Chapters 4 and 5 I reported that thiamin-fortified fish sauce was an efficacious means of increasing eTDP among all the populations we studied: baseline-adjusted endline eTDP was significantly higher among individuals in the HC and LC

groups compared to the control group for non-pregnant, non-lactating women ($P<0.001$), their children aged 12-59 months ($P<0.05$), and pregnant and lactating women ($P<0.05$); LC and HC groups did not differ. Similarly, total breast milk thiamin concentrations were significantly higher among women in both LC and HC groups compared to control ($P<0.05$). eTDP of infants of HC group mothers had significantly higher eTDP than those infants of mothers in the LC and control groups ($P<0.05$), which did not differ. These results demonstrate the potential for thiamin-fortified fish sauce to increase dietary thiamin intake and biochemical thiamin status of rural Cambodians, which in turn could prevent infantile beriberi.

I hypothesized a dose response to the thiamin-fortified fish sauce, postulating HC > LC > control for eTDP in all populations studied. However, I found that there was no statistical difference between eTDP of individuals in the HC and LC groups; the exception being infants. These results suggest a plateau, as consumption of fish sauce containing more than 2 g/L thiamin did not confer higher eTDP. Since a single oral dose of thiamin higher than ~ 5 mg has shown to go largely unabsorbed in healthy adults (20), this finding is not unexpected as this would require fish sauce intakes of only 2.5 mL and 0.625 mL for individuals in LC and HC groups, respectively.

One means of preventing infantile beriberi is to increase the intake of all individuals in the target population, pregnant and lactating women, so that the entire thiamin intake distribution will shift upwards, decreasing the proportion of the population that is at risk of inadequate intake (18,87). As noted in Chapter 3, the ultimate goal of many fortification programs is for 97.5% of the target population to consume more than EAR while also limiting excess intake (87); this overall shift is

of particular importance to that those at highest risk of inadequate intake before fortification. However, the lowest consumers are likely those of lowest socioeconomic status that may not consume as much commercially-produced fish sauce because they choose to make some fish sauce at home; therefore, the target dose must be adjusted to meet the needs of those lowest consumers. As noted in Chapters 4 and 5, more research investigating the optimal fortificant dose is required. In this study, even if individuals were thiamin deficient to begin with the majority of the population likely received more thiamin than required. However, this could be advantageous.

Due to unequal household food distribution, men are most likely to be the highest fish sauce consumers, therefore consuming the highest amount of thiamin. While not the target population for the prevention of infantile beriberi, this high thiamin intake likely poses no harm as there is no UL for thiamin consumption (18). In addition, thiamin needs increase with high carbohydrate intake (14,47). Since polished white rice is the staple in Cambodia, making up an estimated 60% of daily energy intake (8), increased thiamin consumption is likely helpful to ensure optimal energy metabolism. Marginal thiamin deficiency, which causes apathy, fatigue, loss of appetite, and dizziness (45), could also be prevented with improved population-wide thiamin intake.

Despite this, excess thiamin administration should be avoided. A balance must be struck between providing adequate thiamin to the target group, women of childbearing age who are likely the lowest consumers in the population, while protecting the highest consumers, typically men, against excess intake. Fortunately, there is no known toxicity or adverse events from excess thiamin intake, however it is unclear whether long term, chronic excess intake poses risk for

adverse events for an entire population. Economically, it is wasteful to include excess thiamin as it increases costs for producers and consumers. With the long-term goal of sustainability, higher costs for a fortified product compared to the traditional, non-fortified alternative, may decrease sales, especially among the population's poorest and likely most at risk for thiamin inadequacy.

The case of thiamin fortification is not dissimilar to folic acid fortification of white wheat flour in Canada and the United States for the prevention of neural tube defects (NTD) (125). Coats and colleagues showed that not all infants of women with low biochemical thiamin status go on to develop infantile beriberi (11), just as not all women with low folate status will give birth to a NTD-affected baby (126). Fortification of a Canadian staple, white wheat flour, increased the folic acid intake of all Canadian women of childbearing age; this in turn shifted the red cell folate distribution upwards (126) and reduced the incidence of NTD (125,127). The aim of this research was to determine if fish sauce fortification could have the same effect on thiamin status for the prevention of infantile beriberi. One major difference, however, is that there is concern that population-wide folic acid fortification, while ideal for women of childbearing age for the prevention of NTD, poses a risk to elderly as it can mask vitamin B_{12} deficiency and result in irreversible neurological damage (128). There are no such known risks or adverse nutrient interactions associated with high thiamin intakes (18). Therefore, population-wide thiamin fortification can likely shift the eTDP distribution upwards, decreasing the proportion of women at risk of inadequate intake (18,87), and preventing infantile beriberi (57).

6.2.2 Effectiveness of thiamin-fortified fish sauce

This was a proof-of-concept study designed to determine the effect of thiamin-fortified fish sauce consumption on eTDP among rural Cambodian consumers under controlled conditions. Both the randomized design and use of a control group in this study provide convincing evidence that the increase in eTDP seen among individuals in the LC and HC groups can be attributed to consumption of thiamin-fortified fish sauce rather than other factors such as seasonal differences in thiamin intake. As such, this study's design was ideal to assess the objective of this study; I can conclude with confidence that thiamin-fortified fish sauce is an efficacious means of increasing eTDP among consumers. However, this study design has limitations and there is a need to determine the effectiveness of this intervention. While there were attempts made to mimic 'real world' conditions, including *ad libitum* consumption rather than a set consumption rate of fish sauce, more research is required to determine whether thiamin-fortified fish sauce is an ideal means of increasing dietary thiamin intake outside a controlled study environment.

In this study, participants were encouraged to consume fish sauce as they normally would. Although erythrocytes undergo a complete turnover in 120 days, the study duration of 6 months was selected to allow for a 'run in' period of high consumption so that if there were increased fish sauce consumption due to the novelty of free sauce, this would normalize after a few months, therefore allowing biomarkers to reflect more usual intake.

As noted in Chapter 4, 72% of women in the non-pregnant cohort felt that typical household fish sauce consumption changed during the study period; of those who indicated an increase in consumption, the majority indicated a large (59%) or a slight (36%) increase. While only 6% of

women attributed this change to the fact that fish sauce was free, more research is required to predict consumption trends when fish sauce is purchased at market. Such research could help to identify usual fish sauce intake, and aid in determination of the optimal thiamin fortification level of fish sauce in rural Cambodia.

There was no economic assessment of this product in my research. THCl was donated and fish sauce was made on a small scale in one fish sauce factory already outfitted with fortification equipment, therefore it is difficult to estimate the true cost of thiamin-fortified fish sauce. However, we can look to iron-fortified fish sauce for approximate costs. Iron fortification of fish sauce in Cambodia confers an increase of only 2 cents (US$) per litre of fish sauce, which was deemed affordable by >80% of Cambodians in a recent survey (*n*=2,797) (85). Importantly, NaFeEDTA is an expensive fortificant, whereas THCl fortification is much cheaper (87). Since iron fortification equipment and infrastructure are already present in the majority of Cambodian fish sauce factories (85,92), start-up costs to implement thiamin fortification would be minimal. However, future research should investigate the least expensive means of procurement of thiamin in Cambodia at scale.

6.2.3 Fish sauce as a fortification vehicle

In Chapter 3 I reported that THCl was stable in a fish sauce matrix, and that thiamin-fortified fish sauce was well accepted by rural women of childbearing age. One major benefit of fortification is that it requires no behaviour change (87–90); with careful selection of a culturally-appropriate vehicle (a foodstuff commonly consumed by the majority of the population), routine consumption allows for passive consumption of the micronutrient of interest. Fish sauce has the

potential to be an ideal vehicle in Cambodia as it is consumed by 90% of the Cambodian population (85), and is already fortified with iron (84,86). However, there are some limitations of fortified fish sauce in Cambodia that must be considered.

Not all women consume commercially-produced fish sauce; poorer women may make their own fish sauce. Unfortunately there are no data on home production of fish sauce in Cambodia, or whether this practice is seasonal. In addition, as noted in Chapter 4, there is a wide range in quality of commercially-produced fish sauce in Cambodia, with three major categories of fish sauce available at market: high quality, with high protein content, dark colour, and rich fish flavours; medium quality, which is a slightly watered down version of high quality; and low quality, which is more dilute, lighter in colour, and contains artificial colours and flavours. I chose the medium quality fish sauce as a fortification vehicle and, as shown in Chapter 3, thiamin was stable in this matrix. However, the quality of the fish sauce may have been protective, with a higher protein (and therefore α-amino acid) content stabilizing thiamin (104) and the darker colour protecting thiamin against direct sunlight exposure (13,31,38,105). Low quality fish sauce would likely not confer these protective effects, and therefore all qualities of fish sauce should be investigated in the future to determine the stability of thiamin across all potential fish sauce vehicles in Cambodia.

6.2.4 Salt: an alternative thiamin fortification vehicle?

Fish sauce is consumed by, but not necessarily purchased by, 90% of Cambodians. While fish sauce has high potential to be an ideal vehicle for thiamin fortification, future research should also investigate other fortification vehicles. As noted in Chapter 4, salt may have potential to be

an ideal alternate vehicle for thiamin. Salt has been iodized in Cambodia since 1996, and in 2011 a reported 70% of households used iodized salt for both table consumption and production of household preserves including fish sauce (83). Unfortunately, due to a recent lack of government monitoring and quality enforcement, salt iodization had been suboptimal: a recent report noted that 92% of salt iodization in Cambodia did not meet fortification regulations (83). However, government ministries are currently addressing suboptimal salt iodization. Thiamin-fortified fish sauce would not reach households that produce their own fish sauce, but thiamin-fortified salt would not only be purchased by these households, but would also be integrated into homemade fish sauce. And, similar to fish sauce, salt fortification infrastructure already exists in Cambodia (85), making this a cost-effective intervention. With this, future studies should investigate salt as another potential thiamin fortification vehicle in Cambodia.

6.3 Limitations

6.3.1 Need to optimize thiamin fortification dose

The fish sauce utilized in this study was fortified at 2 and 8 g/L thiamin, however our results suggest that the dose can be optimized. While women and children consuming fish sauce fortified at 2 g/L had significantly higher eTDP than those in the control group, the optimal fortification dose may be lower than 2 g/L. As discussed in detail in *Chapter 3*, the EAR cut-point method, with an adjustment upwards due to the uncertainty of the EAR, should ideally be employed to optimize the amount of thiamin added to fish sauce (87). This approach requires the target population's usual intakes of both thiamin and fish sauce, and uses both usual intakes to calculate an optimal thiamin dose to allow for 97.5% of the target population to consume at least the EAR (1.1 mg/d) thiamin (18,87). Since few data are currently available on usual intake of

thiamin or fish sauce among rural Cambodians, I recommend 24 h recalls are collected among representative samples of pregnant and lactating women as well as Cambodian men. Although data from the target group are key, it is also important to understand the potential intake of the highest consumers in the population, adult men (87). In addition, I would conduct another 3-day weighed fish sauce record among a representative group to better quantify usual fish sauce intake.

6.3.2 Lack of infantile beriberi prevalence data

Although there is evidence of low thiamin status throughout Southeast Asia, including the report of lower eTDP among a representative sample of women of childbearing age from Phnom Penh and Prey Veng, Cambodia compared to purportedly thiamin-replete Canadian women from Vancouver reported in Chapter 2, a major limitation of this research is the lack of infantile beriberi prevalence data. Thiamin deficiency has long been described in Southeast Asia: historically in Indonesia and Japan (45), and more recently among Karen refugees on the Thai-Burmese border (68,70), and among mothers and their infants in Laos (77,78) and Cambodia (11,66). However, many of these reports come from specialized groups including refugee populations, or are case reports. The lack of representative prevalence data on infantile beriberi hinders our understanding of the true burden of this disease in Cambodia, and our ability to monitor changes in infantile beriberi-related infant mortality with thiamin interventions. In tandem, the non-specific signs of infantile beriberi such as vomiting, oliguria, anorexia, dyspnea, tachypnea and tachycardia (11,13,19,66,67) may not prompt a trip to the health centre, and since death can occur within hours of clinical presentation (68), it is likely that many cases of infantile

beriberi are not diagnosed. Future research should focus on collection of representative data to describe the prevalence of infantile beriberi in Cambodia and throughout the region.

6.3.3 Defining thiamin deficiency

A major limitation of this research is the lack of consensus on thiamin deficiency cut offs. Described in detail in Chapter 1 (as well as Chapters 2, 4, and 5), the current cut-offs recommended by the Institute of Medicine were based on relatively little data collected decades ago. The Institute of Medicine defines thiamin deficiency as eTDP < 70 nM (18); however this guideline is based on values from one group of Dutch blood donors (*n*=98) in the 1980s and there is confusion as to whether this is a cut-off in whole blood or erythrocytes (18,54). While there are well-established cut-offs for ETKac, this method was not employed here due to issues of poor inter-assay precision, the rapid inactivation of transketolase during blood processing and storage, and reports of underreporting values among chronically deficient groups (see Chapter 1 for more details). Breast milk thiamin interpretive criteria are also somewhat controversial. The current thiamin AI for infants aged 0-6 months was developed from data from only 24 American women published in 1980 (33,34). These small sample sizes, along with improvements in analytical techniques during the past 35 years (35) highlight the need for cut-offs to be re-visited. Future research should focus on the collection of normative data to develop up-to-date deficiency cut-offs for thiamin among women of childbearing age and their infants.

6.3.4 Reaching the poorest groups

Prey Veng was selected as a region of interest for this study because, among other poor health indicators, it had the lowest representation (only 5%) in the highest wealth quintile of

Cambodians; comparatively 90% of individuals in Phnom Penh fell into this quintile (1). However, as shown in Chapters 4 and 5, a high proportion of women in this study (49% of non-pregnant cohort, and 46% of pregnant and lactating cohort) were classified in the top 20% of wealth using income quintiles (2011) from Prey Veng province, Cambodia (99). Therefore the results of this study are likely not representative of those families most at risk of thiamin deficiency and infantile beriberi. As such, future studies should target poor families.

6.4 Future research

Several suggestions for future research are outlined above. Thiamin-fortified fish sauce was an efficacious means of improving thiamin intake and biochemical thiamin status among rural Cambodians. Since infantile beriberi is a totally preventable cause of infant mortality, I encourage further exploration of thiamin fortification to combat this disease in Cambodia. After consultation with nutrition, fortification, and public health experts from government, non-governmental organizations, UN agencies, and academic institutions in Cambodia and globally, I have identified four distinct areas for future research, outlined below.

6.4.1 Determine the prevalence of infantile beriberi

Without representative data on the prevalence of infantile beriberi, it is difficult to quantify the magnitude of this public health issue. While anecdotal reports of infantile beriberi from healthcare workers in rural Cambodia are common, no surveillance data have been collected to date. I believe a screening tool should be developed for community level healthcare workers or volunteers to aid in early identification (and treatment) of infantile beriberi. An epidemiological approach to identify cases, as well as highlight at-risk populations or/or regions would aid in our

understanding of the risk of infantile beriberi (and in turn its required public health response) in Cambodia. Ideally, this surveillance should be conducted nationally; otherwise, effort should be made to collect data from a region that is socioeconomically, demographically, and geographically diverse.

6.4.2 Effectiveness study of thiamin-fortified fish sauce

Thiamin-fortified fish sauce is an efficacious means of improving thiamin intake and biochemical thiamin status, however the effectiveness of this intervention must be explored outside a controlled environment. The high likelihood of increased consumption due to free distribution of fish sauce limits our understanding of both usual fish sauce intake and the optimal fortification level of thiamin in this vehicle. I suggest conducting an effectiveness study as a public-private partnership with fish sauce factories. Ideally, after optimizing the dose (see *6.3.1)* thiamin-fortified fish sauce could be produced in one fish sauce-producing Cambodian province, such as Takeo. Fish sauce producers could receive a subsidy to produce thiamin-fortified fish sauce, and this sauce could be sold through the regular market chain at the same price as the non-fortified equivalent. Social marketing, including posters, radio and television slots, and training of market sellers and influential community members (Village Chiefs, health care providers, Village Health Volunteers) should be employed to encourage purchasing of this specially labeled thiamin-fortified fish sauce. eTDP should be measured in a subset of the population (ensuring sampling of all socioeconomic status groups) before and after introduction of the product to market, ideally over one full year to capture seasonal variation in income, dietary intake, and purchasing behaviours. In addition, detailed data should be collected on fish sauce purchasing

and consumption, and on the knowledge, attitudes, and practices surrounding thiamin deficiency and infantile beriberi, and their prevention with fortified fish sauce.

6.4.3 Thiamin-fortified salt

There are several benefits to thiamin fortification of fish sauce, but recent consultation with government and NGOs in Cambodia relayed that while fish sauce is an ideal vehicle, the poorest of the poor (and likely the most at risk of low thiamin intake) likely purchase salt more often than commercially produced fish sauce. I suggest the exploration of salt as a fortification vehicle for thiamin, including assessment of viability and stability, and if promising, suggest conducting an efficacy trial similar to the one described here. It could be that fortification of both salt and fish sauce could allow for the eradication of infantile beriberi in Cambodia.

6.4.4 Multiple micronutrient fortification

Both fish sauce and salt are already fortified with other micronutrients in Cambodia, salt with iodine, and fish sauce with iron (83–86). While thiamin was the focus of this research due to the serious and immediate implications of infantile beriberi (and related infant mortality), future research should continue to explore fortification with multiple micronutrients. One example could be addressing other micronutrient deficiencies in Cambodia, such as riboflavin (93), through multiple micronutrient fortification.

6.5 Concluding summary

My doctoral research used an iterative approach to investigate and address low thiamin status in rural Cambodia. Prompted by anecdotal evidence and case reports of infantile beriberi in Cambodia and throughout Southeast Asia, and knowing that infantile beriberi is uncommon in regions where women of childbearing age have adequate thiamin intake, I examined the biochemical thiamin status of rural Cambodian women of childbearing age. I found that rural women living in Prey Veng, Cambodia had significantly lower eTDP, a marker of thiamin status, compared to a convenience sample of purportedly thiamin-replete Canadian women. As such, I formulated a stable thiamin-fortified fish sauce with acceptable organoleptic properties, which formed the basis of a double-blind randomized controlled efficacy trial. *Ad libitum* consumption of fortified fish sauce improved eTDP among non-pregnant women of childbearing age (18-45 y) and their children (12-59 mo), and pregnant and lactating women (18-45 y) and their infants (<6 mo). Among lactating women, breast milk thiamin concentrations were also increased through regular consumption of the fortified fish sauce. Therefore, thiamin-fortified fish sauce is an efficacious means of improving thiamin intake and biochemical thiamin status in rural Cambodia. Thiamin-fortified fish sauce has the potential to be a sustainable, cost-effective, and culturally-sensitive intervention to improve thiamin intake and status, and should continue to undergo investigation with the downstream goal to combat infantile beriberi in rural Cambodia.

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Appendix A

Determination of thiamin status in women of childbearing age in rural and urban Cambodia
Questionnaire

THE UNIVERSITY
OF BRITISH COLUMBIA

Determination of thiamin status in women of childbearing age in rural and urban Cambodia

CONFIDENTIAL
All information collected in this survey is strictly confidential and will be used for statistical purposes only.

IDENTIFICATION INFORMATION	
Geographic Identification	**Interviewer Record**
Province: _____ District: _____ Commune: _____ Village/City: _____ Subject ID: __ __ __ __ __	Interviewer Name: _____ Signature: _____ Remarks:
Date of Interview: (DD/MM/YYYY) ___ ___ / ___ ___ / ___ ___ ___ ___	

VERBAL INFORMED CONSENT	
This participant, Subject ID __ __ __ __ __, has read/been read and understands the consent form, and has given voluntary, informed verbal consent to participate in this study.	1. Yes 2. No → Do **not** proceed ____
INCLUSION CRITERIA	
Are you between the ages of 20 – 45 years?	1. Yes 2. No → Do **not** proceed ____
Are you currently pregnant or lactating?	1. Yes → Do **not** proceed 2. No

	____
Are you currently participating in any other study? (For example, are you receiving Sprinkles?)	1. Yes → Do **not** proceed 2. No ____

MODULE 1: PARTICIPANT INFORMATION	
1. What is your name?	
2. How old are you?	_____ years
3. How many children have you given birth to?	_____ children, or ___ N/A → skip to Q7
4. Did you breastfeed your youngest child?	1. Yes 2. No → skip to Q7 ____
5. Until what age did you breastfeed your youngest child?	_____ months
6. How long has it been since you stopped breastfeeding your youngest child?	_____ years, _____ months
7. How many people live in your household?	_____ people
8. Do you have any infants aged 0-6 months living in your household?	1. Yes 2. No → skip to Q10 ____
9. If yes, how many?	_____ infants
10. Do you have any infants aged 7-23 months living in your household?	1. Yes 2. No → skip to Q12 ____
11. If yes, how many?	_____ infants
12. Do you have any children aged 2-17 years living in your household?	1. Yes 2. No → skip to Q14 ____
13. If yes, how many?	_____ children
14. Have you completed any schooling?	1. Yes 2. No → skip to Q16 ____
15. What is the highest level you completed at school?	_____ years
16. What was the income for your household in the past 12 months?	US$_____
17. What was the income for your household last month?	US$_____

MODULE 2: COMSUMPTION OF THIAMIN-CONTAINING FOODS

18. During the last week did you eat any of the following foods?

Food Type	Consumed in last week	If yes, how often?	Amount per typical serving
Bread	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Brown Rice	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Peas	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Beans (kidney and navy)	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Lentils	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Mungbeans	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Peanuts	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Soybeans and Tofu	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Eggs	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	

Organ Meat (liver, kidney, etc.)	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Beef	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Lamb	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Pork	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Poultry (duck and chicken)	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	

MODULE 3: COMSUMPTION OF THIAMINASE-CONTAIING FOODS

19. During the last week did you eat any of the following foods?

Food Type	Consumed in last week	If yes, how often?	Amount per typical serving
Raw Fish	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Fermented Fish	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Shellfish, including snails	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Ferns (Bracken, Fiddlehead, Australian Ferns)	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Betel nut	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Tea (please specify type: _____)	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	

MODULE 4: COMSUMPTION OF FOOD STAPLES

20. During the last week did you eat any of the following foods?

Food Type	Consumed in last week	If yes, how often?	Amount per typical serving
Fish sauce as a condiment	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Fish sauce, in the common pot	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Fish paste as a condiment	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Fish paste, in the common pot	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Soy Sauce as a condiment	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Soy Sauce, in the common pot	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Oyster Sauce	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Salt as a condiment	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Salt, in the common pot	1. Yes 2. No → code, then proceed to next row	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week	

	_____	4. 10+ times per week _____	
Granulated Sugar as a condiment	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Granulated Sugar, in the common pot	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	
Cooking Oil	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____	

MODULE 5: FOOD PURCHASING BEHAVIOURS	
21. The following questions will relate to fish sauce.	
21. a) Do you purchase fish sauce at market?	1. Yes 2. No → code, and proceed to Q22 _____
21. b) Which brand of fish sauce do you typically purchase?	Brand: _____ → if unable to answer, code: 1. No brand – purchased in bulk 2. No brand – homemade by seller _____
21. c) Do you always purchase the same brand of fish sauce?	1. Yes 2. No → code, and proceed to Q 21. e) _____
21. d) If yes, why?	
21. e) How much fish sauce do you purchase at once (volume of container)?	_____ mL
21. f) How long does this amount of fish sauce last in your household?	_____ days
21. g) Under what conditions is fish sauce stored in your home (ie. outside, in sealed container, etc.)?	
21. h) How is fish sauce typically served/prepared for consumption in your household?	
22. The following questions will relate to soy sauce.	
22. a) Do you purchase soy sauce at market?	1. Yes 2. No → code, and proceed to Q23 _____
22. b) Which brand of soy sauce do you typically purchase?	Brand: _____ → if unable to answer, code: 1. No brand – purchased in bulk 2. No brand – homemade by seller _____
22. c) Do you always purchase the same brand of soy sauce?	1. Yes 2. No → code, and proceed to Q22. e) _____

22. d) If yes, why?	
22. e) How much soy sauce do you purchase at once (volume of container)?	_____ mL
22. f) How long does this amount of soy sauce last in your household?	_____ days
22. g) Under what conditions is soy sauce stored in your home (ie. outside, in sealed container, etc.)?	
22. h) How is soy sauce typically served/prepared for consumption in your household?	
23. The following questions will relate to oyster sauce.	
23. a) Do you purchase oyster sauce at market?	1. Yes 2. No → code, and proceed to Q24 _____
23. b) Which brand of oyster sauce do you typically purchase?	Brand: _____ → if unable to answer, code: 1. No brand – purchased in bulk 2. No brand – homemade by seller _____
23. c) Do you always purchase the same brand of oyster sauce?	1. Yes 2. No → code, and proceed to Q 23. e) _____
23. d) If yes, why?	
23. e) How much oyster sauce do you purchase at once (volume of container)?	_____ mL
23. f) How long does this amount of oyster sauce last in your household?	_____ days
23. g) Under what conditions is oyster sauce stored in your home (ie. outside, in sealed container, etc.)?	
23. h) How is oyster sauce typically served/prepared for consumption in your household?	
24. The following questions will relate to fish paste.	
24. a) Do you purchase fish paste at	1. Yes

market?	2. No → code, and proceed to Q25 _____
24. b) Which brand of fish paste do you typically purchase?	Brand: _____ → if unable to answer, code: 1. No brand – purchased in bulk 2. No brand – homemade by seller _____
24. c) Do you always purchase the same brand of fish paste?	1. Yes 2. No → code, and proceed to Q 24. e) _____
24. d) If yes, why?	
24. e) How much fish paste do you purchase at once (volume of container)?	_____ g
24. f) How long does this amount of fish paste last in your household?	_____ days
24. g) Under what conditions is fish paste stored in your home (ie. outside, in sealed container, etc.)?	
24. h) How is fish paste typically served/prepared for consumption in your household?	
25. The following questions will relate to salt.	
25. a) Do you purchase salt at market?	1. Yes 2. No → code, and proceed to Q26 _____
25. b) Which brand of salt do you typically purchase?	Brand: _____ → if unable to answer, code: 1. No brand – purchased in bulk 2. No brand – homemade by seller _____
25. c) Do you always purchase the same brand of salt?	1. Yes 2. No → code, and proceed to Q 25. e) _____
25. d) If yes, why?	
25. e) How much salt do you purchase at once (volume of container)?	_____ g
25. f) How long does this amount of salt	

last in your household?	_____ days
25. g) Under what conditions is salt stored in your home (ie. outside, in sealed container, etc.)?	
25. h) How is salt typically served/prepared for consumption in your household?	
26. The following questions will relate to sugar.	
26. a) Do you purchase sugar at market?	1. Yes 2. No → code, and proceed to Q27 _____
26. b) Which brand of sugar do you typically purchase?	Brand: _____ → if unable to answer, code: 1. No brand – purchased in bulk 2. No brand – homemade by seller _____
26. c) Do you always purchase the same brand of sugar?	1. Yes 2. No → code, and proceed to Q 26. e) _____
26. d) If yes, why?	
26. e) How much sugar do you purchase at once (volume of container)?	_____ g
26. f) How long does this amount of sugar last in your household?	_____ days
26. g) Under what conditions is sugar stored in your home (ie. outside, in sealed container, etc.)?	
26. h) How is sugar typically served/prepared for consumption in your household?	
27. The following questions will relate to cooking oil.	
27. a) Do you purchase cooking oil at market?	1. Yes 2. No → code, and proceed to Q28 _____
27. b) Which brand of cooking oil do you typically purchase?	Brand: _____ → if unable to answer, code:

	1. No brand – purchased in bulk 2. No brand – homemade by seller _____
27. c) Do you always purchase the same brand of cooking oil?	1. Yes 2. No → code, and proceed to Q 27. e) _____
27. d) If yes, why?	
27. e) How much cooking oil do you purchase at once (volume of container)?	_____ mL
27. f) How long does this amount of cooking oil last in your household?	_____ days
27. g) Under what conditions is cooking oil stored in your home (ie. outside, in sealed container, etc.)?	
27. h) How is cooking oil typically served/prepared for consumption in your household?	

MODULE 6: IODIZED SALT TEST	
28. Is this one of the first five households visited in this village?	1. Yes 2. No → **do not test** household salt and skip to Q30 ____
29. If yes, collect a small sample of salt from the home, test this salt using the provided iodine test kit, and code the results.	1. 0 ppm 2. 7 ppm 3. 15 ppm 4. 30 ppm 5. no reaction ____

MODULE 7: ANTHROPOMETRIC MEASUREMENTS	
30. Height of Participant	1) __ __ __ . __ cm 2) __ __ __ . __ cm 3) __ __ __ . __ cm
31. Weight of Participant	1) __ __ . __ __ kg 2) __ __ . __ __ kg 3) __ __ . __ __ kg

បញ្ជីសំណួរ: កំណត់នូវកំរិតវីតាមីនB1 ក្នុងខ្លួនស្ត្រីក្នុងវ័យបន្តពូជនៅក្នុងទីក្រុង និងទីជនបទ នៃប្រទេសកម្ពុជា

ការសំងាត់
រាល់ព័ត៌មានដែលប្រមូលបាននៅក្នុងការសិក្សាស្រាវជ្រាវនេះនឹងត្រូវបានរក្សាជាការសំងាត់ និងប្រើប្រាស់ក្នុង គោលបំណងបែបស្ថិតិប៉ុណ្ណោះ ។

ព័ត៌មានកំណត់សំគាល់	
កំណត់សំគាល់ភូមិសាស្ត្រ	**កំណត់សំគាល់អ្នកសម្ភាសន៍**
ខេត្ត: ..... ស្រុក: ..... ឃុំ: ..... ភូមិ/ក្រុង៖ ..... លេខសំគាល់សំណាក: ☐☐☐☐☐	អ្នកសម្ភាសន៍ ឈ្មោះ ..... ហត្ថលេខា: ..... កំណត់សម្គាល់ .....
កាលបរិច្ឆេទការសម្ភាសន៍: (ថ្ងៃ /ខែ /ឆ្នាំ) __/__/____	

ការអនុញ្ញាតផ្ទាល់មាត់	
អ្នកផ្តល់ចម្លើយ (លេខសំគាល់សំណាក ☐☐☐☐☐) បានអាន ឬត្រូវបានអានឱ្យស្តាប់ យល់ពីលិខិតសុំការអនុញ្ញាតស្មគ្រចិត្ត និងយល់ព្រមដោយផ្ទាល់មាត់ ដើម្បីចូលរួមក្នុងការ សិក្សាស្រាវជ្រាវនេះ	១= ចាស ☐ ២= ទេ → **បញ្ចប់ការសម្ភាសន៍**

ការពិនិត្យមើលលក្ខខណ្ឌអ្នកដែលអាចចូលរួមក្នុងការសម្ភាសន៍	
អាយុពី ២០-៤៥ឆ្នាំ	១= ចាស ☐ ២= ទេ → **មិនត្រូវសម្ភាសន៍ទេ**
កំពុងមានផ្ទៃពោះឬបំបៅដោះកូន	១= ចាស→ **មិនត្រូវសម្ភាសន៍ទេ** ២= ទេ ☐
កំពុងចូលរួមក្នុងការសិក្សាណាមួយ (ឧ. ការទទួលបានម្សៅវីតាមីន)	១= ចាស→ **មិនត្រូវសម្ភាសន៍ទេ** ២= ទេ ☐

ផ្នែកទី ១ ៖ ព័ត៌មានអ្នកចូលរួម	
១. តើអ្នកមានឈ្មោះអ្វី?	_____
២. តើអ្នកមានអាយុប៉ុន្មាន?	☐☐ ឆ្នាំ
៣.តើអ្នកបានផ្តល់កំណើតដល់កូន ប៉ុន្មាននាក់?	☐☐ នាក់ **បើសូន្យនាក់ → សំណួរទី ៧**
៤. តើអ្នកមានបានបំបៅដោះកូនពៅគេបង្អស់របស់អ្នកដែរឬទេ?	១= ចាស ២= ទេ → **សំណួរទី ៧** ☐

៥. តើអ្នកបានបំបៅដោះកូនពៅគេបង្អស់របស់អ្នក ដល់អាយុប៉ុន្មាន?	☐☐ ខែ
៦. រាប់មកដល់ឥឡូវ តើអ្នកផ្តាច់ដោះកូនពៅគេបង្អស់ របស់អ្នកយូរប៉ុណ្ណាហើយ?	១= ☐☐ ខែ ២= ☐☐ ឆ្នាំ
៧. តើមានមនុស្សប៉ុន្មាននាក់រស់នៅក្នុងផ្ទះរបស់អ្នក?	☐☐ នាក់
៨. តើអ្នកមានទារក (អាយុ ០ - ៦ខែ) នៅក្នុងផ្ទះ របស់អ្នកដែរឬទេ?	១= ចាស ២= ទេ → **សំណួរទី ១០** ☐
៩. ប្រសិនបើចាស មានប៉ុន្មាននាក់?	☐ នាក់
១០. តើអ្នកមានកុមារ (អាយុ ៧ - ២៣ខែ) នៅក្នុងផ្ទះ របស់អ្នកដែរឬទេ?	១= ចាស ២= ទេ → **សំណួរទី ១២** ☐
១១. ប្រសិនបើចាស មានប៉ុន្មាននាក់?	☐ នាក់
១២. តើអ្នកមានកុមារ (អាយុ ២ឆ្នាំ - ១៧ឆ្នាំ) នៅក្នុងផ្ទះ របស់អ្នកដែរឬទេ?	១= ចាស ២= ទេ → **សំណួរទី ១៤** ☐
១៣. ប្រសិនបើចាស មានប៉ុន្មាននាក់?	☐ នាក់
១៤. តើអ្នកធ្លាប់ចូលរៀនដែរឬទេ?	១= ចាស ២= ទេ → **សំណួរទី ១៦** ☐
១៥. តើអ្នកបានរៀនដល់កំរិតណា?	☐☐ ឆ្នាំ
១៦. តើគ្រួសាររបស់អ្នករកចំណូលបានប៉ុន្មាន ក្នុងអំឡុងពេល១២ខែកន្លងមកនេះ?	☐☐ ដុល្លាអាមេរិច
១៧. តើគ្រួសាររបស់អ្នករកចំណូលបានប៉ុន្មាន ក្នុងអំឡុងពេល១ខែកន្លងមកនេះ?	☐☐ ដុល្លាអាមេរិច

ផ្នែកទី ២: ការបរិភោគអាហារដែលមានវីតាមីន B1

១៨. ក្នុងអំឡុងពេល១សប្តាហ៍កន្លងមក តើអ្នកមានបរិភោគអាហារណាមួយក្នុងចំណោមអាហារខាងក្រោមដែរឬទេ?

ប្រភេទអាហារ	បានបរិភោគក្នុងសប្តាហ៍មុន	បើបាន ញឹកញាប់ប៉ុណ្ណា?	បរិមាណ ក្នុងពេលបរិភោគម្តង
នំប៉័ង	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
បាយអង្ករសម្រូប	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
សណ្តែកបារាំង	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	

សណ្តែក (សណ្តែកក្រហម សណ្តែកស)	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
សណ្តែក លៃនថាយ	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
សណ្តែកបាយ	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
សណ្តែកដី	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
សណ្តែកសៀង និងគៅហ្ស៊ូ (ទឹកសណ្តែក)	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
ស៊ុត	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
គ្រឿងក្នុង (ថ្លើម ក្រលៀន ជាដើម)	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
សាច់គោ	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
សាច់ចៀម	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
សាច់ជ្រូក	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	

សាច់បក្សី (សាច់ ទា និងសាច់មាន់)	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	

ផ្នែកទី ៣ ៖ ការបរិភោគអាហារដែលមានសារធាតុទីអាមីណាស៊ីស (ប្រឆាំងការបឺតស្រូបវីតាមីន B1)

១៩. ក្នុងសប្តាហ៍មុន តើអ្នកមានបរិភោគអាហារណាមួយក្នុងចំណោមអាហារខាងក្រោមដែរឬទេ?

ប្រភេទអាហារ	បរិភោគក្នុងសប្តាហ៍មុន	បើមាន ញឹកញាប់ប៉ុណ្ណា?	បរិមាណក្នុងពេលបរិភោគម្តង
ត្រីឆៅ	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
ផ្អកឆៅ	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
ខ្យង ខ្ចៅ គ្រំ ងារ លៀស បង្គា	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
ដើមប្រមោយដំរី	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
ស្លា	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
តែ (សូមបញ្ជាក់ ប្រភេទ:_____)	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	

ផ្នែកទី ៤ ៖ ការបរិភោគគ្រឿងផ្សំអាហារ

២០. ក្នុងសប្តាហ៍មុន តើអ្នកមានបរិភោគគ្រឿងផ្សំអាហារណាមួយក្នុងចំណោមគ្រឿងផ្សំអាហារខាងក្រោមដែរ ឬទេ?

ប្រភេទអាហារ	បរិភោគក្នុងសប្តាហ៍មុន	បើមាន ញឹកញាប់ប៉ុណ្ណា?	បរិមាណក្នុងពេលបរិភោគម្តង
ទឹកត្រី	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
ទឹកត្រីដាក់ក្នុងសម្ល	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	

ប្រហុកឆៅ	១. ចាស ២. ទេ → ជួរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
ប្រហុកដាក់ក្នុងសម្ល	១. ចាស ២. ទេ → ជួរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
ទឹកស៊ីអ៊ីវ	១. ចាស ២. ទេ → ជួរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
ទឹកស៊ីអ៊ីវដាក់ក្នុងសម្ល	១. ចាស ២. ទេ → ជួរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
ប្រេងខ្យង	១. ចាស ២. ទេ → ជួរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
អំបិល	១. ចាស ២. ទេ → ជួរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
អំបិលដាក់ក្នុងសម្ល	១. ចាស ២. ទេ → ជួរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
ស្ករស	១. ចាស ២. ទេ → ជួរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
ស្ករសដាក់ក្នុងសម្ល	១. ចាស ២. ទេ → ជួរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	
ប្រេងឆា	១. ចាស ២. ទេ → ជួរបន្ទាប់ ☐	១= ១-៣ដងក្នុងមួយសប្តាហ៍ ២= ៤-៦ដងក្នុងមួយសប្តាហ៍ ៣= ៧-៩ដងក្នុងមួយសប្តាហ៍ ៤= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐	

ផ្នែកទី ៥ ៖ ទំនៀមទំលាប់ក្នុងការទិញអាហារ

២១. ខាងក្រោមគឺជាសំណួរដែលទាក់ទងទៅនឹងទឹកត្រី ។

២១. a) តើអ្នកទិញទឹកត្រីនៅផ្សារដែរឬទេ?	១. ចាស ២. ទេ → **សំណួរទី ២២** ☐

២១. b) តើអ្នកនិយមទិញទឹកត្រីម៉ាកអ្វី?	ម៉ាក:.....ប្រសិនបើមិនអាចឆ្លើយ សូមដាក់កូដ ១=គ្មានម៉ាក-ទិញរាយ ២=គ្មានម៉ាក-អ្នកលក់ធ្វើដោយខ្លួនឯង ☐
២១. c) តើអ្នកតែងតែទិញទឹកត្រីម៉ាកដដែលៗដែរឬ ទេ?	១. ចាស ២. ទេ → **សំណួរទី ២១. e)** ☐
២១. d) ប្រសិនបើចាស ហេតុអ្វី?	....
២១. e) តើអ្នកទិញទឹកត្រីម្តងចំណុះប៉ុន្មាន? (ចំណុះប៉ុន្មានមីលីលីត្រ?)	☐☐☐ មីលីលីត្រ
២១. f) តើអ្នកអាចប្រើទឹកត្រីនោះបានរយៈពេល ប៉ុន្មានថ្ងៃ?	☐☐ ថ្ងៃ
២១. g) តើអ្នកទុកដាក់ទឹកត្រីយ៉ាងដូចម្តេចនៅក្នុងផ្ទះ? (ទុកចោលនៅខាងក្រៅ ឬទុកក្នុងដបដែលមានគំរបបិទជិត...)	....
២១. h) តើតាមធម្មតាអ្នករៀបចំទឹកត្រីយ៉ាងដូចម្តេច សម្រាប់បរិភោគនៅក្នុងផ្ទះរបស់អ្នក?	....
២២. ខាងក្រោមគឺជាសំណួរដែលទាក់ទងទៅនឹងទឹកស៊ីអ៊ីវ ។	
២២. a) តើអ្នកទិញទឹកស៊ីអ៊ីវនៅផ្សារដែរឬទេ?	១. ចាស ២. ទេ → **សំណួរទី ២៣** ☐
២២. b) តើអ្នកនិយមទិញទឹកស៊ីអ៊ីវម៉ាកអ្វី?	ម៉ាក:.....ប្រសិនបើមិនអាចឆ្លើយ សូមដាក់កូដ ១=គ្មានម៉ាក-ទិញរាយ ២=គ្មានម៉ាក-អ្នកលក់ធ្វើដោយខ្លួនឯង ☐
២២. c) តើអ្នកតែងតែទិញទឹកស៊ីអ៊ីវម៉ាកដដែលៗ ដែរឬទេ?	១. ចាស ២. ទេ → **សំណួរទី ២២. e)** ☐
២២. d) ប្រសិនបើចាស ហេតុអ្វី?	....
២២. e) តើអ្នកទិញទឹកស៊ីអ៊ីវម្តងចំណុះប៉ុន្មាន? (ចំណុះប៉ុន្មានមីលីលីត្រ?)	☐☐☐ មីលីលីត្រ
២២. f) តើអ្នកអាចប្រើទឹកស៊ីអ៊ីវនោះបានរយៈពេល ប៉ុន្មានថ្ងៃ?	☐☐ ថ្ងៃ
២២. g) តើអ្នកទុកដាក់ទឹកស៊ីអ៊ីវយ៉ាងដូចម្តេចនៅក្នុងផ្ទះ? (ទុកចោលនៅខាងក្រៅ ឬទុកក្នុងដបដែលមានគំរបបិទជិត...)	....
២២. h) តើតាមធម្មតាអ្នករៀបចំទឹកស៊ីអ៊ីវយ៉ាងដូចម្តេចសម្រាប់បរិភោគនៅក្នុងផ្ទះរបស់អ្នក?	....
២៣. ខាងក្រោមគឺជាសំណួរដែលទាក់ទងទៅនឹងប្រេងឆ្ងង ។	
២៣. a) តើអ្នកទិញប្រេងឆ្ងងនៅផ្សារដែរឬទេ?	១. ចាស ២. ទេ → **សំណួរទី ២៤** ☐

២៣. b) តើអ្នកនិយមទិញប្រេងខ្យងម៉ាកអ្វី?	ម៉ាក:.....ប្រសិនបើមិនអាចឆ្លើយ សូមដាក់កូដ ១=គ្មានម៉ាក-ទិញរាយ ២=គ្មានម៉ាក-អ្នកលក់ធ្វើដោយខ្លួនឯង ☐
២៣. c) តើអ្នកតែងតែទិញប្រេងខ្យងម៉ាកដដែលៗដែរឬទេ?	១. ចាស ២. ទេ → **សំណួរទី ២៣. e)** ☐
២៣. d) ប្រសិនបើចាស ហេតុអ្វី?	....
២៣. e) តើអ្នកទិញប្រេងខ្យងម្តងចំណុះប៉ុន្មាន? (ចំណុះប៉ុន្មាន?)	☐☐☐ មីលីលីត្រ
២៣. f) តើអ្នកអាចប្រើប្រេងខ្យងនោះបានរយៈពេលប៉ុន្មានថ្ងៃ?	☐☐ ថ្ងៃ
២៣. g) តើអ្នកទុកដាក់ប្រេងខ្យងយ៉ាងដូចម្តេចនៅក្នុងផ្ទះ? (ទុកចោលនៅខាងក្រៅ ឬទុកក្នុងដបដែលមានគំរបបិទជិត...)	....
២៣. h) តើតាមធម្មតាអ្នករៀបចំប្រេងខ្យងយ៉ាងដូចម្តេចសម្រាប់បរិភោគនៅក្នុងផ្ទះរបស់អ្នក?	....
២៤. ខាងក្រោមគឺជាសំណួរដែលទាក់ទងទៅនឹងប្រហុក ។	
២៤. a) តើអ្នកទិញប្រហុកនៅផ្សារដែរឬទេ?	១. ចាស ២. ទេ → **សំណួរទី ២៥** ☐
២៤. b) តើអ្នកនិយមទិញប្រហុកម៉ាកអ្វី?	ម៉ាក:.....ប្រសិនបើមិនអាចឆ្លើយ សូមដាក់កូដ ១=គ្មានម៉ាក-ទិញរាយ ២=គ្មានម៉ាក-អ្នកលក់ធ្វើដោយខ្លួនឯង ☐
២៤. c) តើអ្នកតែងតែទិញប្រហុកម៉ាកដដែលៗដែរ ឬទេ?	១. ចាស ២. ទេ → **សំណួរទី ២៤. e)** ☐
២៤. d) ប្រសិនបើចាស ហេតុអ្វី?	....
២៤. e) តើអ្នកទិញប្រហុកម្តងប៉ុន្មានក្រាម?	☐☐☐ ក្រាម
២៤. f) តើអ្នកអាចប្រើប្រហុកនោះបានរយៈពេល ប៉ុន្មានថ្ងៃ?	☐☐ ថ្ងៃ
២៤. g) តើអ្នកទុកដាក់ប្រហុកយ៉ាងដូចម្តេចនៅក្នុងផ្ទះ? (ទុកចោលនៅខាងក្រៅ ឬទុកក្នុងប្រអប់ដែលមានគំរបបិទជិត...)	....
២៤. h) តើតាមធម្មតាអ្នករៀបចំប្រហុកយ៉ាង ដូចម្តេចសម្រាប់ការបរិភោគនៅក្នុងផ្ទះរបស់អ្នក?	....
២៥. ខាងក្រោមគឺជាសំណួរដែលទាក់ទងទៅនឹងអំបិល ។	
២៥. a) តើអ្នកទិញអំបិលនៅផ្សារដែរឬទេ?	១. ចាស ២. ទេ → **សំណួរទី ២៦** ☐

២៥. b) តើអ្នកនិយមទិញអំបិលម៉ាកអ្វី?	ម៉ាក:.....ប្រសិនបើមិនអាចឆ្លើយ សូមដាក់កូដ ១=គ្មានម៉ាក-ទិញរាយ ២=គ្មានម៉ាក-អ្នកលក់ធ្វើដោយខ្លួនឯង ☐
២៥. c) តើអ្នកតែងតែទិញអំបិលម៉ាកដដែលៗដែរ ឬទេ?	១. ចាស ២. ទេ → **សំណួរទី ២៥. e)** ☐
២៥. d) ប្រសិនបើចាស ហេតុអ្វី?	....
២៥. e) តើអ្នកទិញអំបិលម្តងប៉ុន្មានក្រាម?	☐☐☐ ក្រាម
២៥. f) តើអ្នកអាចប្រើអំបិលនោះបានរយៈពេល ប៉ុន្មានថ្ងៃ?	☐☐ ថ្ងៃ
២៥. g) តើអ្នកទុកដាក់អំបិលយ៉ាងដូចម្តេចនៅក្នុងផ្ទះ? (ទុកចោលនៅខាងក្រៅ ឬទុកក្នុងប្រអប់ដែល មានគំរបបិទជិត...)	....
២៥. h) តើតាមធម្មតាអ្នករៀបចំអំបិលយ៉ាង ដូចម្តេចសម្រាប់ការបរិភោគនៅក្នុងផ្ទះរបស់អ្នក?	....
២៦. ខាងក្រោមគឺជាសំណួរដែលទាក់ទងទៅនឹងស្ករស ។	
២៦. a) តើអ្នកទិញស្ករសនៅផ្សារដែរឬទេ?	១. ចាស ២. ទេ → **សំណួរទី ២៧** ☐
២៦. b) តើអ្នកនិយមទិញស្ករសម៉ាកអ្វី?	ម៉ាក:.....ប្រសិនបើមិនអាចឆ្លើយ សូមដាក់កូដ ១=គ្មានម៉ាក-ទិញរាយ ២=គ្មានម៉ាក-អ្នកលក់ធ្វើដោយខ្លួនឯង ☐
២៦. c) តើអ្នកតែងតែទិញស្ករសម៉ាកដដែលៗដែ រឬទេ?	១. ចាស ២. ទេ → **សំណួរទី ២៦. e)** ☐
២៦. d) ប្រសិនបើចាស ហេតុអ្វី?	....
២៦. e) តើអ្នកទិញស្ករសម្តងប៉ុន្មានក្រាម?	☐☐☐ ក្រាម
២៦. f) តើអ្នកអាចប្រើស្ករសនោះបានរយៈពេលប៉ុន្មាន ថ្ងៃ?	☐☐ ថ្ងៃ
២៦. g) តើអ្នកទុកដាក់ស្ករសយ៉ាងដូចម្តេចនៅក្នុងផ្ទះ? (ទុកចោលនៅខាងក្រៅ ឬទុកក្នុងប្រអប់ដែលមាន គំរបបិទជិត...)	....
២៦. h) តើតាមធម្មតាអ្នករៀបចំស្ករសយ៉ាងដូចម្តេច សម្រាប់ការបរិភោគនៅក្នុងផ្ទះរបស់អ្នក?	....
២៧. ខាងក្រោមគឺជាសំណួរដែលទាក់ទងទៅនឹងប្រេងឆា ។	
២៧. a) តើអ្នកទិញប្រេងឆានៅផ្សារដែរឬទេ?	១. ចាស ២. ទេ → **សំណួរទី ២៨** ☐

២៧. b) តើអ្នកនិយមទិញប្រេងឆាម៉ាកអ្វី?	ម៉ាក:.....ប្រសិនបើមិនអាចឆ្លើយ សូមដាក់កូដ ១=គ្មានម៉ាក-ទិញរាយ ២=គ្មានម៉ាក-អ្នកលក់ធ្វើដោយខ្លួនឯង ☐
២៧. c) តើអ្នកតែងតែទិញប្រេងឆាម៉ាកដដែលៗដែរ ឬទេ?	១. ចាស ២. ទេ → **សំណួរទី ២៧. e)** ☐
២៧. d) ប្រសិនបើចាស ហេតុអ្វី?	....
២៧. e) តើអ្នកទិញប្រេងឆាម្តងប៉ុន្មានមីលីលីត្រ?	☐☐☐ មីលីលីត្រ
២៧. f) តើអ្នកអាចប្រើប្រេងឆានោះបានរយៈពេលប៉ុន្មានថ្ងៃ?	☐☐ ថ្ងៃ
២៧. g) តើអ្នកទុកដាក់ប្រេងឆាយ៉ាងដូចម្តេចនៅក្នុងផ្ទះ? (ទុកចោលនៅខាងក្រៅ ឬទុកក្នុងដបដែលមានគំរបបិទជិត...)	....
២៧. h) តើតាមធម្មតាអ្នករៀបចំប្រេងឆាយ៉ាង ដូចម្តេចសម្រាប់បរិភោគនៅក្នុងផ្ទះរបស់អ្នក?	....

ផ្នែកទី ៦ ៖ អំបិលអ៊ីយ៉ូដ	
២៨. តើនេះជាផ្ទះមួយក្នុងចំណោមផ្ទះចំនួន៥ដំបូងដែលបាន សម្ភាសន៍មែនទេ?	១=ចាស ២=ទេ→**ទៅសំណួរ៣០** ☐
២៩. សូមអំបិលពីអ្នកផ្តល់ចម្លើយបន្តិច រួចធ្វើតេស្តដោយបន្តក់ទឹកសម្រាប់ពិនិត្យមើលជាតិអ៊ីយ៉ូដ ព្រមទាំងកត់ត្រាចម្លើយ។	១= 0 ppm ២= 7 ppm ៣= 15 ppm ៥= 30 ppm ៥=គ្មានអ៊ីយ៉ូដ ☐
តើអ្នកបានប្រើប្រេងកូឡា នៅពេលណាមួយដែរឬទេក្នុងអំឡុងពេលពីរសប្តាហ៍កន្លងមកនេះ?	១=ចាស ២=ទេ
ប្រសិនបើបានប្រើ តើអ្នកប្រើចំនួនប៉ុន្មានដងក្នុងមួយសប្តាហ៍	..... ដង
ជាធម្មតា តើអ្នកទិញប្រេងកូឡាម៉ាកអ្វី?	.....
ផ្នែកទី ៧ ៖ ការវាស់កម្ពស់ និងថ្លឹងទម្ងន់	
៣០. កម្ពស់របស់អ្នកចូលរួម	១) ☐☐☐.☐ ស.ម ២) ☐☐☐.☐ ស.ម ៣) ☐☐☐.☐ ស.ម
៣១. ការថ្លឹងទម្ងន់របស់អ្នកចូលរួម	១) ☐☐.☐ គ.ក ២) ☐☐.☐ គ.ក ៣) ☐☐.☐ គ.ក

Sensory evaluation of thiamin fortified fish sauce
QUESTIONNAIRE

ការវាយតម្លៃទៅលើវីតាមីន បេ១ ដែលបានដាក់បញ្ចូលក្នុងទឹកត្រីបញ្ជីសំនួរ

Date: ___ ___ / ___ ___ / ___ ___ ___ ___ (DD/MM/YYYY)
ថ្ងៃ: (ថ្ងៃ/ខែ/ឆ្នាំ)

Q1. Participant ID: ☐☐ លេខកូដអ្នកចូលរួម:

Q2. Age of Participant: ☐☐ years អាយុអ្នកចូលរួម: ឆ្នាំ

Q3. In general, what is your attitude towards fish sauce? ជាទូទៅ តើអ្នកយល់យ៉ាងដូចម្តេច ចំពោះទឹក ត្រី ?	1. negative 2. neutral 3. positive ☐
Q4. Do you consume fish sauce on a regular basis? តើអ្នកតែងតែបរិភោគទឹកត្រីឬ ?	1. yes 2. no ☐
Q5. Do you purchase fish sauce on a regular basis? តើទឹកត្រីដែលអ្នកបរិភោគជាប្រចាំ អ្នកទិញគេឬ ?	1. yes 2. no ☐

Triangle Test
សាកល្បងតាមវិធីសាស្ត្រត្រីកោណ

Q6. Coded Sample Set Provided: គំរូលេខកូដដែលបានផ្តល់:

1. 2 G + 1 O
2. 1 G + 2 O
3. 2 G + 1 P
4. 1 G + 2 P
5. 2 P + 1 O
6. 1 P + 2 O

☐

Q7. "Different" Sample Selected from Triangle Test:
(ការខុសគ្នា) ការជ្រើសរើសគំរូតាមរយៈការសាកល្បងវិធីសាស្ត្រត្រីកោណ

1. P
2. G
3. O

☐

Paired Preference Test **ការសាកល្បងការពេញចិត្តចំនួនពីរ**
Q8. Sampling set provided to participant: ឈុតនៃសំណាកដែលបានផ្តល់អោយអ្នកចូលរួម: 1. P, G 2. G, P ☐
Q9. Preferred Sample of Paired Preference Test: សំណាកដែលចូលចិត្តជាងគេក្នុងចំណោមការសាកល្បងការពេញចិត្តទាំងពីរ:
1. P 2. G ☐

Nine-Point Hedonic Scale **៩ចំណុចសំរាប់ការវាយតម្លៃតាមការចូលចិត្ត**	
Q10. Sampling set provided to participant: ឈុតនៃសំណាកដែលបានផ្តល់អោយអ្នកចូលរួម: 1. P, G, O 2. G, P, O 3. P, O, G 4. G, O, P 5. O, P, G 6. O, G, P ☐	
Sample សំណាក	Score ពិន្ទុ
Q11. P	☐ out of 9
Q12. G	☐ out of 9
Q13. O	☐ out of 9

Appendix C

Assessment of cultural factors to aid in designing a suitable thiamin-fortified fish sauce bottle for use in rural Cambodia
Focus Group Discussion Guide

Topic: Thiamin fortified fish sauce packaging design
Investigators: Food, Nutrition and Health, University of British Columbia, Canada and Helen Keller International Cambodia
Total Participant Time Required: 45-60 minutes

Introduction & Information

Q001.	Interview #:	Q006.	Village:
Q002.	Province: PREY VENG	Q007.	Consent form read & signed: YES NO
Q003.	District:	Q008.	Interview Date: (DD/MM/YYYY)
Q004.	Commune:	Q009.	Enumerator ID #:

Participant Information

Participant 1: ID Number: ___ ___ - ___ Age: _____ Child under 5? ☐ Pregnant? ☐
Participant 2: ID Number: ___ ___ - ___ Age: _____ Child under 5? ☐ Pregnant? ☐
Participant 3: ID Number: ___ ___ - ___ Age: _____ Child under 5? ☐ Pregnant? ☐
Participant 4: ID Number: ___ ___ - ___ Age: _____ Child under 5? ☐ Pregnant? ☐
Participant 5: ID Number: ___ ___ - ___ Age: _____ Child under 5? ☐ Pregnant? ☐

Hello. My name is _____ and this is _____ and we work with Helen Keller International. We are here today to discuss the package of a product that we are designing for Cambodian families. This product is being developed to help improve the health of women and infants living in Prey Veng province. If it works, we will be working with the Ministry of Health and Ministry of Planning to provide it to more people living in Cambodia. Before then, we want to make sure the packaging is appealing to you and other Cambodian women. We would like to show you a few images and bottles designs and hear your opinion about the colours, images, and text. Your ideas and impressions are very important to us, so please feel free to express whatever you think. If you agree to participate in this discussion, we will be spending just under an hour together. We appreciate your participation.

To start, I will show you the product.

I. Product Determination and Typical Use

Q101. Can you identify this product? Please describe what you see.

Q102. This is fish sauce. Do you use fish sauce when you cook? Do you typically buy your fish sauce in the market?

II. Bottle Cap Colours

I will now show you five bottles of the same fish sauce.

Interviewer: Place the five bottles – with white, green, red, orange, and purple lids - next to each other. Allow participants to pick up and examine the bottles.

Q201. Tell me about the bottles.
Probe: Do you notice any differences between the bottles?

Q202.a) Tell me about the colour of the bottle lids.

Q202.b) Are there any colours that you really like? **Why?**

Q202.c) Are there any colours that you do not like? **Why?**

Q203. What do you think other caregivers in Cambodia will feel about these five colours? **Why?**

Q204. Do these colours have any meaning to you? Do they remind you of anything? If so, is it a good, neutral, or bad feeling?
Probe: Religious, political, company colours, etc.

III. Label Designs

I will now show you some labels we have designed for this fish sauce. Please feel free to take a closer look at them and wrap them around the bottles to help you visualize the complete product.
Interviewer: Present the respondents with **ALL** five designs at the same time.

Q301. Is there any label we showed you that is **your favorite**? Why do you prefer this label?
Probe: Tell me more about the colours of this label. Tell me more about the design of this label. Is there a specific part of the label you particularly enjoy?

Q302. Do you think most caregivers across Cambodia would **also prefer** this design? Why or why not?

Q303. Is there any label we showed you that you **do not like**? Why do you dislike this label?
Probe: Tell me more about the colours of this label. Tell me more about the design of this label. Is there a specific part of the label you dislike?

Q304. Do you think most caregivers across Cambodia would **also dislike** this design? Why or why not?

Q305. Are there any changes you would like to see made to your favourite label(s)?

IV. Comparing and Matching Labels with Bottle Lid Colours

Q401. Can you tell me how your favorite label(s) match with the colours of the bottle lid you identified earlier?
Probe: Do any colours clash? Do any colours look very good or very bad with the label?

This is the end of our discussion. Thank you very much for your time!

Extra space for notes (write down which question number it relates to) or additional observations (e.g. body language, moods)

ការវាយតម្លៃអំពីកត្តាវប្បធម៌នានា ដើម្បីជាជំនួយក្នុងការរចនា ដបទឹកត្រីមានបញ្ចូលជីវជាតិ*B1* សម្រាប់ប្រើប្រាស់នៅតាមតំបន់ជនបទប្រទេសកម្ពុជា

គោលការណ៍ណែនាំសម្រាប់ការពិភក្សាជាក្រុម

ប្រធានបទ: ការរចនាស្លាកសញ្ញាដបទឹកត្រីមានបញ្ចូលជីវជាតិ B1
អ្នកសិក្សាស្រាវជ្រាវ: មហាវិទ្យាល័យស្បៀង អាហារូបត្ថម្ភ និងសុខភាព នៃសកលវិទ្យាល័យប៊ីស៊ី ប្រទេសកាណាដា និង អង្គការហេឡែន ខេលល័រ អន្តរជាតិ ប្រចាំប្រទេសកម្ពុជា
រយៈពេលសម្រាប់ការសម្ភាសន៍: ៤៥ ទៅ ៦០នាទី

ការណែនាំ និងព័ត៌មាន

Q001.	លេខកូដអ្នកសម្ភាសន៍:	Q006.	ភូមិ:
Q002.	ខេត្ត: ព្រៃវែង	Q007.	បានអានទម្រង់យល់ព្រមផ្តល់ការសម្ភាសន៍ និងទទួលបានការយល់ព្រម: ចាស ទេ
Q003.	ស្រុក	Q008.	កាលបរិច្ឆេទការសម្ភាសន៍:
Q004.	ឃុំ	Q009.	លេខកូដអ្នកសម្ភាសន៍:

ព័ត៌មានអ្នកចូលរួម

អ្នកចូលរួមទី១៖ លេខកូដ___ ___ អាយុ___ ___ មានកូនអាយុក្រោម៥ឆ្នាំ? ☐ មានផ្ទៃពោះ? ☐
អ្នកចូលរួមទី២៖ លេខកូដ___ ___ អាយុ___ ___ មានកូនអាយុក្រោម៥ឆ្នាំ? ☐ មានផ្ទៃពោះ? ☐
អ្នកចូលរួមទី៣៖ លេខកូដ___ ___ អាយុ___ ___ មានកូនអាយុក្រោម៥ឆ្នាំ? ☐ មានផ្ទៃពោះ? ☐
អ្នកចូលរួមទី៤៖ លេខកូដ___ ___ អាយុ___ ___ មានកូនអាយុក្រោម៥ឆ្នាំ? ☐ មានផ្ទៃពោះ? ☐
អ្នកចូលរួមទី៥៖ លេខកូដ___ ___ អាយុ___ ___ មានកូនអាយុក្រោម៥ឆ្នាំ? ☐ មានផ្ទៃពោះ? ☐

ជំរាបសួរ! ខ្ញុំឈ្មោះ.....ចំណែកគាត់ឈ្មោះ..... ហើយយើងទាំងអស់គ្នាធ្វើការនៅអង្គការ ហេឡែន ខេលល័រអន្តរជាតិ។ ផលិតផលនេះត្រូវបានផលិតឡើងដើម្បីជួយធ្វើអោយប្រសើរឡើងដល់សុខភាពស្ត្រីនិងទារក ដែលរស់នៅក្នុងខេត្តព្រៃវែង។ ប្រសិនបើវាមានប្រសិទ្ធភាព យើងនឹងធ្វើការសហការជាមួយក្រសួងសុខាភិបាល និងក្រសួងផែនការ ដើម្បីចែកចាយវា ទៅដល់ប្រជាជនដទៃទៀតដែលរស់នៅក្នុងប្រទេសកម្ពុជា។ ដូចនេះ យើងចង់អោយមានការប្រាកដថា ការរចនាសំបកដប ត្រូវចិត្តរបស់អ្នក និងស្ត្រីកម្ពុជាដទៃទៀត។ យើងសូមបង្ហាញអ្នកនូវរូបភាព និងដបមួយចំនួន ព្រមទាំងសូមអោយអ្នកផ្តល់យោបល់អំពី ពណ៌ រូបភាព និងអក្សរ។ គំនិត និងការចាប់អារម្មណ៍របស់អ្នក គឺមានសារៈសំខាន់ណាស់សម្រាប់ខ្ញុំ ដូចនេះសូមបញ្ចេញយោបល់ដោយសេរី។ ប្រសិនបើអ្នកយល់ព្រមចូលរួមក្នុងការពិភាក្សានេះ យើងនឹងអាចចំណាយពេលប្រហែលជាតិចជាងមួយម៉ោង។ យើងសូមថ្លែងអំណរគុណចំពោះការចូលរួមរបស់អ្នក។

មុននឹងចាប់ផ្តើម ខ្ញុំនឹងបង្ហាញអ្នកនូវផលិតផលនេះ

I. ការកំណត់ និងការប្រើប្រាស់ផលិតផលជាធម្មតា

Q101. តើអ្នកស្គាល់ផលិតផលនេះដែរឬទេ? សូមពិពណ៌នាអ្វីដែលអ្នកបានឃើញ?

Q102. វាគឺជាទឹកត្រី។ តើអ្នកតែងតែប្រើទឹកត្រីដែរឬទេ នៅពេលដាំស្ល? តើអ្នកតែងតែទិញទឹកត្រីនៅផ្សារមែនទេ?

II. ពណ៌គម្របដប

ឥឡូវខ្ញុំនឹងបង្ហាញអ្នកនូវដបដែលមានទឹកត្រីដូចគ្នាចំនួន៥
អ្នកសម្ភាសន៍: សូមតំរៀបដបចំនួន៥ ដែលមានគម្របពណ៌ស បៃតង ក្រហម ទឹកក្រូច និងពណ៌ស្វាយខ្ចីតាមលំដាប់។ អោយអ្នកចូលរួមកាន់ និងពិនិត្យមើលដបទាំងនោះ។

Q201. សូមប្រាប់ខ្ញុំអំពីដបទាំងនោះ។
ការស្នង់: តើអ្នកមានឃើញអ្វីខុសគ្នាដែរឬទេ ពីដបមួយទៅដបមួយ?

Q202.a) សូមប្រាប់ខ្ញុំអំពីពណ៌របស់គម្របដប។

Q202.b) តើមានពណ៌អ្វីខ្លះដែលអ្នកពេញចិត្ត? ហេតុអ្វី?

Q202.c) តើមានពណ៌អ្វីខ្លះដែលអ្នកពេញមិនពេញចិត្ត? ហេតុអ្វី?

Q203. តើអ្នកគិតថាអ្នកថៃទាំកុមារដទៃទៀតនៅប្រទេសកម្ពុជា គិតយ៉ាងដូចម្តេចចំពោះពណ៌ទាំងប្រាំនេះ? ហេតុអ្វី?

Q204. តើអ្នកគិតថាពណ៌ទាំងនេះ នឹងមានអត្ថន័យចំពោះស្ត្រីដទៃទៀតដែរឬទេ? តើអ្នកគិតថាវានឹងរំលឹកពួកគាត់អំពីអ្វីមួយដែរឬទេ? ប្រសិនបើចាស តើអ្នកគិតថា វាគឺជាអារម្មណ៍ល្អ ធម្មតា ឬមិនល្អ?
ការស្នង់: សាសនា នយោបាយ ពណ៌ក្រុមហ៊ុន។ល។

III. ការរចនាស្លាកសញ្ញា

ឥឡូវខ្ញុំនឹងបង្ហាញអ្នកនូវស្លាកសញ្ញាមួយចំនួន ដែលយើងបានរចនាសម្រាប់ទឹកត្រីនេះ។ សូមអ្នកមើលអោយបានជិត ហើយយកវាទៅរំជុំវិញដប ដើម្បីជួយអោយអ្នកមើលឃើញរូបរាងផលិតផលទាំងស្រុង។
អ្នកសម្ភាសន៍: សូមបង្ហាញអ្នកផ្តល់ចម្លើយនូវស្លាកសញ្ញាទាំងប្រាំនៅពេលតែមួយ។

Q301.តើក្នុងចំណោមស្លាកសញ្ញាដែលខ្ញុំបានបង្ហាញ មានស្លាកសញ្ញាណាមួយដែល**<u>អ្នកពេញចិត្ត</u>**ដែរឬទេ? ហេតុអ្វីបានជាអ្នកចូលចិត្តវា? ស្នង់: សូមប្រាប់ខ្ញុំបន្ថែមទៀតអំពីពណ៌របស់ស្លាកសញ្ញានេះ។ សូមប្រាប់ខ្ញុំបន្ថែមទៀតអំពីការរចនាស្លាកសញ្ញានេះ។ តើមានផ្នែកណាមួយនៃស្លាកសញ្ញានេះ ដែលអ្នកចូលចិត្តជាពិសេសដែរឬទេ?
Q302. អ្នកគិតថាអ្នកថៃទាំកុមារនៅប្រទេសកម្ពុជាភាគច្រើន **ក៏នឹងចូលចិត្ត**ការរចនានេះដែរឬទេ? បើចូលចិត្តហេតុអ្វី ឬបើមិនចូលចិត្តហេតុអ្វី?
Q303. តើក្នុងចំណោមស្លាកសញ្ញាដែលខ្ញុំបានបង្ហាញ មានស្លាកសញ្ញាណាមួយដែលអ្នក**<u>មិនពេញចិត្ត</u>**ដែរឬទេ? ហេតុអ្វីបានជាអ្នកចូលចិត្តវា? ស្នង់: សូមប្រាប់ខ្ញុំបន្ថែមទៀតអំពីពណ៌របស់ស្លាកសញ្ញានេះ។ សូមប្រាប់ខ្ញុំបន្ថែមទៀតអំពីការរចនាស្លាកសញ្ញានេះ។ តើមានផ្នែកណាមួយនៃស្លាកសញ្ញានេះ ដែលអ្នកមិនចូលចិត្តដែរឬទេ?

Q304. តើអ្នកគិតថាអ្នកថៃទាំកុមារនៅប្រទេសកម្ពុជាភាគច្រើន ក៏នឹង**មិនចូលចិត្ត**ការចនានេះដែរឬទេ?បើចូលចិត្តហេតុអ្វី ឬបើមិនចូលចិត្តហេតុអ្វី?

Q305. តើអ្នកមានចង់ផ្លាសប្តូរទៅលើស្លាកសញ្ញា ដើម្បីអោយវាក្លាយជាស្លាកសញ្ញាដែលពេញចិត្តរបស់អ្នកដែរឬទេ?

IV. ការប្រៀបធៀប និងផ្គូរផ្គងស្លាកសញ្ញាជាមួយពណ៌គម្របដប

Q401. តើអ្នកអាចប្រាប់ ខ្ញុំថាស្លាកសញ្ញាដែលអ្នកចូលចិត្តត្រូវគ្នានឹងពណ៌គម្របដបដែលអ្នកបានកំណត់ពីពេលមុនយ៉ាងដូចម្តេច?
ស្នង់:តើមានពណ៌ណាដែលមិនស៊ីគ្នាដែរឬទេ? តើមានពណ៌ណាដែលមើលទៅសម ឬមិនសមទៅនឹងស្លាកសញ្ញាដែរឬទេ?

ការពិភាក្សារបស់យើងបានបញ្ចប់ហើយ។ អរគុណជាអនេកកប្បការចំពោះការចំណាយពេលចូលរួម!

កន្លែងបន្ថែមសម្រាប់កត់ត្រា (សូមសរសេរលេខសំណួរដែលទាក់ទង) ឬការអង្កេតបន្ថែម (ឧ. ភាសាកាយវិការ អារម្មណ៍)

Appendix D

Thiamin fortified fish sauce as a means of combating infantile beriberi in rural Cambodia
Observed Weighed Fish Sauce Record

OBSERVED WEIGHED FISH SAUCE RECORD

Thiamin fortified fish sauce as a means of combating infantile beriberi in rural Cambodia

Participant ID: ___ ___ ___ ___ ___ **Date**: ___ ___ / ___ ___ / ___ ___ ___ ___ (DD/MM/YYYY) **Enumerator ID**: _____ **Visit Number**: _____

1. How many people eat from your family pot?	_____ people
2. Did you, your husband, or your youngest child (≥ 12 months) consume fish sauce between sunset yesterday and sunrise this morning?	1. Yes 2. No → code, and proceed to Q4
3. If yes, please estimate the amount of fish sauce consumed.	a) Participant: _____ mL b) Participant's Husband: _____ mL c) Youngest Child (≥ 12 months): _____ mL

4. Record all fish sauce consumed by the participant, her husband, and her youngest child (≥ 12 months; if applicable) from sunrise to sunset.

PARTICIPANT'S YOUNGEST CHILD ≥ 12 MONTHS (IF APPLICABLE)						
Time of Consumption	**Method of Consumption** 1=stir fry 2=condiment 3=soup 4=other; specify	**Weight of MEAL BEFORE Fish Sauce Added** *(g)*	**Weight of MEAL AFTER Fish Sauce Added** *(g)*	**Cooking Time** *(minutes)*	**Weight of PORTION BEFORE Consumption** *(g)*	**Weight of PORTION AFTER Consumption** *(g)*

Thiamin fortified fish sauce as a means of combating infantile beriberi in rural Cambodia
Observed Weighed Fish Sauce Record

PARTICIPANT						
Time of Consumption	**Method of Consumption** 1=stir fry 2=condiment 3=soup 4=other; specify	**Weight of <u>MEAL</u> <u>BEFORE</u> Fish Sauce Added** *(g)*	**Weight of <u>MEAL</u> <u>AFTER</u> Fish Sauce Added** *(g)*	**Cooking Time** *(minutes)*	**Weight of <u>PORTION</u> <u>BEFORE</u> Consumption** *(g)*	**Weight of <u>PORTION</u> <u>AFTER</u> Consumption** *(g)*

Thiamin fortified fish sauce as a means of combating infantile beriberi in rural Cambodia
Observed Weighed Fish Sauce Record

PARTICIPANT'S HUSBAND						
Time of Consumption	**Method of Consumption** 1=stir fry 2=condiment 3=soup 4=other; specify	**Weight of <u>MEAL</u> <u>BEFORE</u> Fish Sauce Added** *(g)*	**Weight of <u>MEAL</u> <u>AFTER</u> Fish Sauce Added** *(g)*	**Cooking Time** *(minutes)*	**Weight of <u>PORTION</u> <u>BEFORE</u> Consumption** *(g)*	**Weight of <u>PORTION</u> <u>AFTER</u> Consumption** *(g)*

ការកត់ត្រាទម្ងន់ទឹកត្រី

ការបញ្ចូលជីវជាតិ*B1* ក្នុងទឹកត្រីជាមធ្យោបាយក្នុងការទប់ស្កាត់ជំងឺបេរីបេរីក្នុងតំបន់ជនបទប្រទេសកម្ពុជា

លេខកូដអ្នកផ្តល់ចម្លើយ:___ ___ ___ ___ ___ កាលបរិច្ឆេទ:___ ___/___ ___/___ ___ ___ ___ (ថ្ងៃ/ខែ/ឆ្នាំ)
លេខកូដអ្នកសម្ភាសន៍:_____ លេខទស្សន:កិច្ច:_____

1. តើក្នុងគ្រួសារអ្នកមានសមាជិកប៉ុន្មាននាក់?(ហូបបាយឆ្នាំងជាមួយគ្នា)	_____ នាក់
2. តើអ្នក ប្តីរបស់អ្នក ឬកូនពៅគេបង្អស់ (អាយុចាប់ពី១២ខែឡើង) បានបរិភោគទឹកត្រីក្នុងអំឡុងពេលថ្ងៃលិចកាលពីម្សិលមិញ រហូតដល់ថ្ងៃរះកាលពីព្រឹកមិញនេះដែរឬទេ?	1. ចាស 2. ទេ →សូមរំលងទៅសំណួរទី៤
3. ប្រសិនបើបាន សូមស្មានពីបរិមាណទឹកត្រីដែលបានបរិភោគ	a) ស្ត្រីគោលដៅ: _____ មីលីលីត្រ b) ប្តីរបស់ស្ត្រីគោលដៅ: _____ មីលីលីត្រ c) កូនពៅគេបង្អស់(អាយុចាប់ពី១២ខែឡើង): ____មីលីលីត្រ

4.កត់ត្រាទឹកត្រីទាំងអស់ដែលបានបរិភោគដោយអ្នកចូលរួម ប្តីរបស់គាត់ និងកូនពៅគេបង្អស់(អាយុចាប់ពី១២ខែឡើង ប្រសិនបើមាន): ចាប់តាំងពីថ្ងៃរះរហូតដល់ថ្ងៃលិច

កូនពៅគេបង្អស់របស់ស្ត្រីគោលដៅ អាយុចាប់ពី១២ខែឡើង (ប្រសិនបើមាន)						
ពេលនៃការបរិភោគ	**វិធីចំអិន** 1=ឆា 2=ហូបផ្ទាល់ 3=សំឡ 4=ផ្សេងៗ សូមបញ្ជាក់	ទម្ងន់<u>អាហារ</u> **<u>មុនពេល</u>** បន្ថែមទឹកត្រី (ក្រាម)	ទម្ងន់<u>អាហារ</u> **<u>បន្ទាប់ពី</u>** បន្ថែមទឹកត្រី (ក្រាម)	**ពេលវេលាចំអិន** (នាទី)	ទម្ងន់ចំណែកអាហារ **<u>មុនពេល</u>**បរិភោគ (ក្រាម)	ទម្ងន់ចំណែកអាហារ **<u>ក្រោយពេល</u>**បរិភោគ (ក្រាម)

ស្ត្រីគោលដៅ						
ពេលនៃការបរិភោគ	**វិធីចំអិន** 1=ឆា 2=ហូបផ្ទាល់ 3=សំឡ 4=ផ្សេងៗ សូមបញ្ជាក់	ទម្ងន់អាហារ **<u>មុនពេល</u>** បន្ថែមទឹកត្រី (ក្រាម)	ទម្ងន់អាហារ **<u>បន្ទាប់ពី</u>** បន្ថែមទឹកត្រី (ក្រាម)	**ពេលវេលាចំអិន** (នាទី)	ទម្ងន់ចំណែកអាហារ**<u>មុនពេល</u>**បរិភោគ (ក្រាម)	ទម្ងន់ចំណែកអាហារ**<u>ក្រោយពេល</u>**បរិភោគ (ក្រាម)

Appendix E

Thiamin fortified fish sauce as a means of combating infantile beriberi in rural Cambodia
Baseline Questionnaire: WOMEN OF CHILDBEARING AGE COHORT

a place of mind

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BASELINE QUESTIONNAIRE
WOMEN OF CHILDBEARING AGE COHORT
Thiamin-fortified fish sauce as a means of combating infantile beriberi in rural Cambodia

CONFIDENTIAL
All information collected in this survey is strictly confidential and will be used for statistical purposes only.

IDENTIFICATION INFORMATION	
Geographic Identification	**Interviewer Record**
Province: _____PREY VENG_____ District: _____ Commune: _____ Village: _____ Subject ID: __ __ __ __ __	Interviewer: ___ ___ Name: _____ Signature: _____ Remarks:
Date of Interview: (DD/MM/YYYY) ___ ___/ ___ ___/ ___ ___ ___ ___	

INFORMED CONSENT	
This participant, Subject ID __ __ __ __ __, has read/been read and understands the consent form, and has given voluntary, informed verbal consent to participate in this study.	1. Yes 2. No → Do **not** proceed ____

YOUNGEST CHILD (12- 59 MONTHS)	
i) What is the name of your youngest child (aged 12 – 59 months)?	
ii) What the date of birth of your youngest child (aged 12 – 59 months), and how old is s/he?	____ / ____ / _____ (DD/MM/YYYY) (_____ months)

MODULE 1: INCLUSION CRITERIA	
iii) Are you the female head of your household?	1. Yes 2. No → Do **not** proceed ____
iv) Are you between the ages of 18 – 45 years?	1. Yes 2. No → Do **not** proceed ____
v) Do you have at least one child aged 12 – 59 months?	1. Yes 2. No → Do **not** proceed ____
vi) Do you plan to move within the next six months?	1. Yes → Do **not** proceed 2. No ____
vii) Are you currently participating in any other study/intervention? (For example, are children in your household receiving micronutrient powders?)	1. Yes → Do **not** proceed 2. No ____
viii) Will you agree to exclusively feed your entire family **only** the fish sauce provided by the study team for the next six months?	1. Yes 2. No → Do **not** proceed ____
ix) Are you willing to provide a venous blood sample, and allow us to take a venous blood sample from your youngest child this week, and six months from now?	1. Yes 2. No → Do **not** proceed ____
x) Are you taking any dietary supplements containing B vitamins?	1. Yes → Do **not** proceed 2. No ____
xi) Are you pregnant, or are you hoping to become pregnant in the next six months?	1. Yes → Do **not** proceed 2. No ____

MODULE 2: PARTICIPANT INFORMATION	
1. How old are you?	_____ years
2. How many people currently live in your household (defined as eating from the same pot each day)?	_____ people
3. How many children have you given birth to?	_____ children, or **If 0 → skip to Q12**
4. I would like to ask about the children you have given birth to who are currently living in your household. How many children are within the following age ranges?	a) 0 - 6 months ____ b) 7 - 23 months ____ c) 2 - 5 years ____ d) >5 years ____
5. How old is your **youngest** child?	____ / ____ / _____ (DD/MM/YYYY) (_____ months)
6. Is your **youngest** child _____ (youngest child 12 - 59 months)?	1. Yes 2. **No** ____
7. Did you breastfeed, or are you currently breastfeeding, your **youngest** child?	1. Yes 2. **No → skip to Q11** ____
8. Until what age did you **exclusively** breastfeed your **youngest** child (fed **only** breast milk, not water, coconut milk, or any foods)?	_____ months 77 = still currently **exclusively** breastfeeding
9. Until what age did you continue to breastfeed your **youngest** child while also providing other foods?	_____ months 77 = still currently **exclusively** breastfeeding 99 = still currently breastfeeding
10. How long has it been since you **stopped** breastfeeding your **youngest** child?	_____ months 77 = still currently **exclusively** breastfeeding 99 = still currently breastfeeding
11. At what age did your **youngest** child start receiving complimentary foods (foods provided in addition to breast milk)?	_____ months 77 = still currently **exclusively** breastfeeding
12. Have you completed any schooling?	1. Yes 2. **No → skip to Q14** ____
13. What is the highest level of school you attended?	1. Primary school 2. Lower Secondary school 3. Upper Secondary school 4. Higher education ____
14. Did your husband/partner completed any schooling?	1. Yes 2. **No → skip to Q16** ____
15. What is the highest level of schooling your husband/partner attended?	1. Primary school 2. Lower Secondary school 3. Upper Secondary school 4. Higher education ____
16. What was the income for your household last **month**?	US$_____
17. What was the income for your household in the past **12 months**?	US$_____

MODULE 3: FOOD INTAKE

18. I would like to ask you about the foods and drinks that you may have consumed **yesterday** during the day or night. I want to know how often you ate the food, approximately how much of the food you ate in a typical serving, and how it was consumed.

Food Type	Consumed yesterday	If yes, how often?	Amount per typical serving (g or mL)	Consumed alone, or with other foods?
a) White Rice, and white rice borbor	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
b) Bread, brown rice, noodles, porridge, or other foods made from grains? (**Other than white rice**.)	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
c) Pumpkin, carrots, squash, or sweet potatoes that are yellow or orange inside?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
d) White potatoes, white yams, manioc, cassava, or any other foods made from roots?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
e) Dark leafy green vegetables (eg. kang kong)	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
f) Ripe mangoes, papayas or any other yellow or orange fruits?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
g) Other fruits or vegetables?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____

h) Liver, kidney, heart, or other organ meats?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
i) Meat, such as beef, pork, lamb, goat, chicken, or duck?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
j) Eggs?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
k) Fresh or dried fish and shellfish (including snails, crab, squid)?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
l) Foods made from beans, peas, lentils, or nuts?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
m) Cheese or other foods made from milk?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
n) Foods made with oil, fat, or butter?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
o) Snake, frog, rats, or insects?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
p) Sugary foods such as pastry, cakes, chocolates, sweets, or candies?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____

19. How many meals and snacks did you consume yesterday?	a) _____ meals, **and** b) _____ snacks
20. Was yesterday's food intake typical/usual for you?	**1. Yes→ skip to Q22** 2. No ____

21. If no, why was it not typical/usual?	1. I was ill 2. I was not hungry 3. There was not enough food ____ 4. It was a celebration (ate more or differently) 5. Other – specify:_____
22. Who is primarily responsible for food preparation in your household?	1. Self (woman) 2. Husband/partner 3. Grandmother 4. Grandfather 5. Male children ____ 6. Female children 7. Other – specify:_____

MODULE 4: FISH SAUCE

23. Now I would like to ask you about your fish sauce consumption. During the **past week**, did you consume fish sauce …

Food Type	Consumed in last week	If yes, how often?	Amount per typical serving (mL)	Describe consumption/ food preparation
a) Fish sauce as a condiment	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____		1. fish sauce **alone** in small bowl 2. fish sauce with chilies/garlic/MSG/lime/lemon in small bowl 3. other – specify: _____ _____
b) Fish sauce, in the common pot	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____		1. in soup 2. In stir fry 3. In khor 4. other – specify: _____ _____
c) Other – specify: _____	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____		

24. During the **past day** (yesterday, during the day and at night), did you consume fish sauce …

Food Type	Consumed yesterday	If yes, how often?	Amount per typical serving (mL)	Describe consumption/ food preparation
a) Fish sauce as a condiment	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. fish sauce **alone** in small bowl 2. fish sauce with chilies/garlic/MSG/lime/lemon in small bowl 3. other – specify: _____ _____

b) Fish sauce, in the common pot	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. in soup 2. In stir fry 3. In khor 4. other – specify: _____ _____
c) Other – specify: _____	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		

25. The following questions will relate to buying fish sauce.

25. a) Do you purchase fish sauce at market?	1. Yes 2. **No → code, and proceed to Q26** _____
25. b) Which brand of fish sauce do you typically purchase?	Brand: _____ → if unable to answer, code: 1. Has brand, but unknown 2.. No brand – purchased in bulk 3. No brand – homemade by seller _____
25. c) Do you always purchase the same brand of fish sauce?	1. Yes 2. **No → code, and proceed to Q25e)** _____
25. d) If yes, why?	1. delicious 2. inexpensive 3. habit 4. Only fish sauce available 5. Other – specify : _____ _____
25. e) How much fish sauce do you purchase at once (volume of container)?	_____ mL
25. f) How long does this amount of fish sauce last in your household?	_____ days
25. g) How much does this fish sauce usually cost?	_____ Riel
25. h) Under what conditions is fish sauce stored in your home?	1. on a shelf at room temperature (in the shade) 2. on a shelf at room temperature (in the sun) 3. in a refrigerator, or in a cool box with ice 4. other - specify: _____ _____
25. i) How is fish sauce typically served/prepared for consumption in your household?	1. in soup 2. in stir fry 3. as a condiment (poured on food, or for dipping) 4. In soup AND as a condiment 5. In stir-fry AND as a condiment 6.. other - specify: _____ _____

26. I would now like to ask about how your family eats fish sauce.	
26. a) In your household, who consumes the most fish sauce?	1. you (woman) 2. your husband/partner 3. grandmother 4. grandfather 5. other - specify: _____ _____
26. b) Why does this person consume the most fish sauce?	1. they have the largest appetite 2. they prefer fish sauce the most 3. they are fed the largest portion of each meal 4. other - specify: _____ _____
26. c) When fish sauce is consumed from the common pot, do all adult members of your household consume the same amount?	1. **Yes → code, and proceed to Q27** 2. No 3. fish sauce not used in common pot _____
26. d) If no, why?	1. person who works the most eats more 2. husband eats more 3. person who prefers the food from the common pot the most eats more 4. other - specify: _____ _____
27. I would now like to ask your opinion about fortified products. A fortified product is a food that has added vitamins or minerals to improve health and prevent disease. One example of a fortified food is iodized salt, which is fortified to prevent goiters.	
27. a) Do you regularly purchase iodized salt?	1. Yes 2. **No → code, and proceed to Q27c)** _____
27.b) If yes, why? **Explain, then proceed to Q27.d)**	1. because you know it will improve health 2. because it is the only salt available 3. because a trusted person (family member, village chief, health professional) recommended it 4. because you prefer the taste 5. other - specify: _____ _____
27. c) If no, why?	1. because it is more expensive 2. because iodized salt is not available 3. because you do not like the taste 4. other - specify: _____ _____
27. d) Have you heard of iron-fortified fish sauce?	1. Yes 2. **No → code, and proceed to Q27h)** _____
27. e) If yes, from where?	1. media (TV, radio, newspapers) 2. posters in the village 3. heard from a trusted person (family member, village chief, health professional) 4. Other: _____ _____

27. f) Have you purchased iron fortified fish sauce?	1. Yes 2. **No → code, and proceed to Q27h)** _____
27. g) If yes, why?	1. because you know it will improve health 2. because it is the only fish sauce available 3. because a trusted person (family member, village chief, health professional) recommended it 4. because you prefer the taste 5. other – specify: _____ _____
27. h) If a fish sauce became available that contained both iron and a vitamin that would improve your health (vitamin B_1), would you purchase this product?	1. Yes 2. **No → code, and proceed to 27j)** _____
27. i) If yes, why? **Explain, then proceed to Q26k)**	1. improves health 2. recommended by a trusted person (family member, village chief, health professional) 3. product deemed safer or quality more carefully regulated 4. other people are purchasing it 5. Other - specify: _____ _____
27. j) If no, why? **Explain, then proceed to Q28**	
27. k) How much **more** money would you be willing to pay for this product (as compared to what you usually spend on fish sauce)?	_____ Riel, OR 1. family does not purchase fish sauce ____

MODULE 5: KNOWLEDGE OF THIAMIN DEFICIENCY AND BERIBERI	
28. Have you ever heard of vitamin B_1, also known as thiamin?	1. Yes 2. No _____
29. Have you ever heard of vitamin B_1 (thiamin) deficiency, also known as beriberi?	1. Yes 2. **No → code, and proceed to Q33** _____
30. Do you know any symptoms of vitamin B_1 (thiamin) deficiency or beriberi in infants less than 6 months old?	1. Yes 2. **No → code, and proceed to Q33** _____
31. What are the symptoms of vitamin B_1 (thiamin) deficiency or beriberi in infants less than 6 months old?	
32. How do you treat vitamin B_1 (thiamin) deficiency or beriberi in infants less than 6 months old?	
33. Until what age should infants be **exclusively** breastfed (fed **only** breast milk, not water, coconut water, or any foods)?	_____ months 88 = unknown
34. At what age should children start receiving complimentary foods (foods that are provided to children in addition to breast	_____ months 88 = unknown

milk)?	
35. Until what age should children **continue** to be breastfed while also eating other foods?	_____ months 88 = unknown
36. What are the first foods a child should eat, other than breast milk?	1. _____ 2. _____ 3. _____
37. When should a child start eating foods from the family pot?	_____ months 88 = unknown

MODULE 6: ANTHROPOMETRIC MEASUREMENTS	
Anthropometrics of Participant and Youngest Child (12-59 months)	
38. Height of **Participant**	1) __ __ __ . __ cm 2) __ __ __ . __ cm 3) __ __ __ . __ cm
39. Weight of **Participant**	1) __ __ . __ __ kg 2) __ __ . __ __ kg 3) __ __ . __ __ kg
40. Height/Length of **Youngest Child** (12-59 months)	1) __ __ __ . __ cm 2) __ __ __ . __ cm 3) __ __ __ . __ cm
41. Weight of **Youngest Child** (12-59 months)	1. __ __ . __ __ kg 2. __ __ . __ __ kg 3. __ __ . __ __ kg
42. Mid-upper Arm Circumference (MUAC) of **Youngest Child** (12-59 months) **Note**: If child's MUAC<11.5cm, refer to health centre.	1. __ __ . __ cm 2. __ __ . __ cm

Thank you so much for your time!

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បញ្ជីសំណួរការអង្កេតមូលដ្ឋានគ្រឹះ(ក្រុមស្ត្រីក្នុងវ័យបន្តពូជ)

ទឹកត្រីបញ្ចូលជីវជាតិB1 ជាមធ្យោបាយក្នុងការទប់ស្កាត់ជម្ងឺបេរីបេរីចំពោះទារក នៅតាមជនបទប្រទេសកម្ពុជា

ការសំងាត់

រាល់ព័ត៌មានដែលប្រមូលបាននៅក្នុងការសិក្សាស្រាវជ្រាវនេះនឹងត្រូវបានរក្សាជាការសំងាត់ និងប្រើប្រាស់ក្នុង គោលបំណងបែបស្ថិតិប៉ុណ្ណោះ ។

ព័ត៌មានកំណត់សំគាល់	
កំណត់សំគាល់ភូមិសាស្ត្រ	**កំណត់សំគាល់អ្នកសម្ភាសន៍**
ខេត្ត: ..... ស្រុក: ..... ឃុំ: ..... ភូមិ ..... លេខសំគាល់សំណាក: ☐☐☐☐☐	អ្នកសម្ភាសន៍ ☐☐ ឈ្មោះ ..... ហត្ថលេខា: ..... កំណត់សម្គាល់ .....
កាលបរិច្ឆេទការសម្ភាសន៍: (ថ្ងៃ /ខែ /ឆ្នាំ) __/__/____	

ការអនុញ្ញាតផ្ទាល់មាត់	
អ្នកផ្តល់ចម្លើយ (លេខសំគាល់សំណាក ☐☐☐☐☐) បានអាន ឬបានស្តាប់ យល់ពីលិខិតសុំការអនុញ្ញាតស្មគ្រចិត្ត និងយល់ព្រមដោយផ្ទាល់មាត់ ដើម្បីចូលរួមក្នុងការសិក្សាស្រាវជ្រាវនេះ	1= ចាស ☐ 2= ទេ → **បញ្ចប់ការសម្ភាសន៍**

កូនពៅគេបង្អស់	
i) តើកូនពៅគេបង្អស់របស់អ្នកឈ្មោះអ្វី (អាយុពី១២-៥៩ខែ)?	……..
ii) តើកូនពៅគេបង្អស់របស់អ្នកកើតនៅថ្ងៃខែឆ្នាំណា (អាយុពី១២-៥៩ខែ)?	**ថ្ងៃ** ☐☐ **ខែ** ☐☐ **ឆ្នាំ** ☐☐☐☐ **អាយុ** ☐☐ **ខែ**
ផ្នែកទី1. លក្ខខណ្ឌដែលអាចចូលរួមក្នុងការសិក្សា	
iii) តើអ្នកជាស្ត្រីមេគ្រួសារមែនដែរឬទេ?	1= ចាស 2= ទេ → **មិនត្រូវសម្ភាសន៍ទេ** ☐
iv) តើអ្នកមានអាយុចន្លោះពី១៨ទៅ៤៥ឆ្នាំមែនដែរឬទេ?	1= ចាស 2= ទេ → **មិនត្រូវសម្ភាសន៍ទេ** ☐
v) តើអ្នកមានកូនអាយុចន្លោះពី១២ខែ ដល់៥៩ខែដែរឬទេ?	1= ចាស 2= ទេ → **មិនត្រូវសម្ភាសន៍ទេ** ☐
vi) ក្នុងអំឡុងពេល៦ខែបន្ទាប់ តើអ្នកមានគម្រោងផ្លាស់ទីលំនៅដែរឬទេ?	1= ចាស→ **មិនត្រូវសម្ភាសន៍ទេ** 2= ទេ ☐
vii) បច្ចុប្បន្ន តើអ្នកកំពុងចូលរួមជាមួយការសិក្សា/កិច្ចអន្តរាគមន៍ណាមួយដែរឬទេ? (ឧ. កូនរបស់អ្នកកំពុងទទួលម្សៅមីក្រូសារជាតិ)	1= ចាស→ **មិនត្រូវសម្ភាសន៍ទេ** 2= ទេ ☐
viii) ក្នុងអំឡុងពេល៦ខែបន្ទាប់ តើអ្នកយល់ព្រមក្នុងការប្រើ**<u>តែទឹកត្រី</u>**ដែលផ្តល់ដោយក្រុមការងាររបស់យើង សម្រាប់ការបរិភោគក្នុងគ្រួសារទាំងមូលដែរឬទេ?	1= ចាស 2= ទេ → **មិនត្រូវសម្ភាសន៍ទេ** ☐
ix) តើអ្នកយល់ព្រមចូលរួមក្នុងការបូមឈាម និងយល់ព្រមឱ្យគេបូមឈាមកូនពៅគេបង្អស់របស់អ្នកនៅថ្ងៃស្អែក និងម្តងទៀតនៅរយៈពេល៦ខែក្រោយ ដែរឬទេ?	1= ចាស 2= ទេ → **មិនត្រូវសម្ភាសន៍ទេ** ☐
x) តើអ្នកមានកំពុងលេបថ្នាំបន្ថែម មានជីវជាតិឱដែរឬទេ?	1= ចាស→ **មិនត្រូវសម្ភាសន៍ទេ** 2= ទេ ☐
xi) តើអ្នកកំពុងមានផ្ទៃពោះ ឬមានគម្រោងថានឹងមានផ្ទៃពោះក្នុងអំឡុងពេល៦ខែបន្ទាប់ទៀត ដែរឬទេ?	1= ចាស→ **មិនត្រូវសម្ភាសន៍ទេ** 2= ទេ ☐

ផ្នែកទី 2 ៖ ព័ត៌មានអ្នកចូលរួម	
1. តើអ្នកមានអាយុប៉ុន្មាន?	☐☐ឆ្នាំ
2. បច្ចុប្បន្ននេះ តើមានមនុស្សប៉ុន្មាននាក់រស់នៅក្នុងផ្ទះរបស់	☐☐ នាក់

អ្នក? (រាប់អ្នកដែលហូបបាយជាមួយគ្នា រាល់ថ្ងៃ)	
3. តើអ្នកបានផ្តល់កំណើតដល់កូន ប៉ុន្មាននាក់?	☐☐ នាក់ **បើសូន្យនាក់ → សំណួរទី 12**
4. ខ្ញុំសូមសួរអ្នកអំពីកូនបង្កើតរបស់អ្នក ដែលកំពុងរស់នៅក្នុងផ្ទះអ្នក។ តើមានប៉ុន្មាននាក់ដែលមានអាយុ?	a) 0 - 6 ខែ ☐ b) 7 - 23 ខែ ☐ c) 2 - 5 ឆ្នាំ ☐ d) >5 ឆ្នាំ ☐
5. តើកូនពៅគេរបស់អ្នកអាយុប៉ុន្មាន?	**ថ្ងៃ** ☐☐ **ខែ** ☐☐ **ឆ្នាំ** ☐☐☐☐ **អាយុ** ☐☐ **ខែ**
6. តើកូនពៅគេរបស់អ្នក ជាកូនពៅដែលមានអាយុពី១២ដល់៥៩ខែ ដែរឬទេ?	1= ចាស 2= ទេ ☐
7. តើអ្នកមានបានឬកំពុងបំបៅដោះកូនពៅគេបង្អស់របស់អ្នកដែរឬទេ?	1= ចាស 2= ទេ → **រំលងទៅសំណួរទី11** ☐
8. តើអ្នកបានបំបៅតែ**<u>ទឹកដោះម្តាយមួយមុខគត់</u>**ដល់កូនពៅគេបង្អស់របស់អ្នកដល់អាយុប៉ុន្មាន (បំបៅតែទឹកដោះម្តាយតែមួយមុខគត់ គ្មានទឹក ទឹកដូង ទឹកដោះគោ ឬអាហារផ្សេងៗទៀត)?	ខែ ☐☐ 77=បច្ចុប្បន្ននៅបំបៅទឹកដោះម្តាយតែ១មុខគត់
9. តើអ្នកបានបន្តបំបៅកូនដោយទឹកដោះម្តាយ ជាមួយនឹងការផ្តល់អាហារផ្សេងៗទៀតដល់កូនពៅគេបង្អស់របស់អ្នកដល់អាយុប៉ុន្មាន?	ខែ ☐☐ 77=បច្ចុប្បន្ននៅបំបៅដោះម្តាយតែ១មុខគត់ 99=បច្ចុប្បន្ននៅបំបៅដោះម្តាយ
10. រាប់មកដល់ឥឡូវ តើអ្នកផ្តាច់ដោះកូនពៅគេបង្អស់ របស់អ្នកយូរប៉ុណ្ណាហើយ?	☐☐ ខែ 77=បច្ចុប្បន្ននៅបំបៅទឹកដោះម្តាយតែ១មុខគត់ 99=បច្ចុប្បន្ននៅបំបៅដោះម្តាយ
11. តើកូនពៅគេបង្អស់របស់អ្នក ចាប់ផ្តើមហូបអាហារបន្ថែមនៅអាយុប៉ុន្មាន (ក្រៅពីទឹកដោះម្តាយ)?	ខែ ☐☐ 77=បច្ចុប្បន្ននៅបំបៅដោះម្តាយ
12. តើអ្នកធ្លាប់ចូលរៀនដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 14** ☐
13. តើអ្នកបានរៀនដល់កំរិតណា?	1= បឋមសិក្សា 2= អនុវិទ្យាល័យ 3= វិទ្យាល័យ 4= ឧត្តមសិក្សា ☐
14. តើប្តីរបស់អ្នកធ្លាប់ចូលរៀនដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 16** ☐

15. តើប្តីរបស់អ្នកបានរៀនដល់កំរិតណា?	1= បឋមសិក្សា 2= អនុវិទ្យាល័យ ☐ 3= វិទ្យាល័យ 4= ឧត្តមសិក្សា
16. តើគ្រួសាររបស់អ្នករកចំណូលបានប៉ុន្មាន ក្នុងអំឡុងពេល១ខែកន្លងមកនេះ?	ដុល្លាអាមេរិច ☐☐☐☐
17. តើគ្រួសាររបស់អ្នករកចំណូលបានប៉ុន្មាន ក្នុងអំឡុងពេល ១២ខែកន្លងមកនេះ?	ដុល្លាអាមេរិច ☐☐☐☐

ផ្នែកទី 3: ការបរិភោគអាហារ

18. ខ្ញុំសូមសួរអ្នកអំពីអាហារ និងភេសជ្ជៈ ដែលអ្នកបានបរិភោគ **កាលពីម្សិលមិញ** នៅពេលថ្ងៃ ឬពេលយប់។ ខ្ញុំចង់ដឹងពីចំនួនដង បរិមាណអាហារ និងរបៀបដែលអ្នកបានបរិភោគ។

ប្រភេទអាហារ	**បានបរិភោគកាលពីម្សិលមិញ**	**បើបាន ញឹកញាប់ប៉ុណ្ណា?**	**បរិមាណក្នុងពេលបរិភោគម្តង (ក្រាម ឬមីលីលីត្រ**	**បរិភោគតែមួយមុខ ឬលាយជាមួយអាហារផ្សេងទៀត?**
a. បាយអង្ករសម្រិត/បបរអង្ករសម្រិត	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត ☐ រៀបរាប់:.....
b នំប៉័ង/បាយអង្ករសំរូប/មី/បបរ ឬអាហារធ្វើពីគ្រាប់ធញ្ញជាតិផ្សេងទៀត? (ក្រៅពីអង្ករសម្រិត)	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត ☐ រៀបរាប់:.....
c. ល្ពៅ ការ៉ុត ឬដំឡូងជ្វាសាច់ពណ៌លឿង ឬពណ៌ទឹកក្រូច	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត ☐ រៀបរាប់:.....
d. ដំឡូងជ្វាសាច់ពណ៌ស ដំឡូងមី ត្រាវ សាគូ ឬអាហារផ្សេងៗធ្វើពីមើមរុក្ខជាតិ	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត ☐ រៀបរាប់:.....
e. បន្លែស្លឹកពណ៌បៃតងចាស់ (ឧ. ត្រកួន)	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត ☐ រៀបរាប់:.....
f. ស្វាយទុំ ល្ពៅទុំ ឬផ្លែឈើពណ៌លឿងទុំដទៃទៀត?	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត ☐ រៀបរាប់:.....

g. បន្លែ ឬផ្លែឈើដទៃទៀត?	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារ ផ្សេងទៀត ☐ រៀបរាប់:.....
h. ថ្លើម ក្រលៀន បេះដូង ឬគ្រឿងក្នុងដទៃទៀត?	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារ ផ្សេងទៀត ☐ រៀបរាប់:.....
i. សាច់សត្វ ដូចជាសាច់គោ សាច់ជ្រូក សាច់ចៀម សាច់ពពែ សាច់មាន់ សាច់ទា?	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារ ផ្សេងទៀត ☐ រៀបរាប់:.....
j. ស៊ុត?	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារ ផ្សេងទៀត ☐ រៀបរាប់:.....
k. ត្រីស្រស់ ឬត្រីងៀត ខ្យង ខ្ចៅ ក្តាម មឹក?	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារ ផ្សេងទៀត ☐ រៀបរាប់:.....
L. អាហារធ្វើពីសណ្តែក ឬសណ្តែកដី	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារ ផ្សេងទៀត ☐ រៀបរាប់:.....
m. ឈីស ឬអាហារធ្វើពីទឹកដោះគោ?	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារ ផ្សេងទៀត ☐ រៀបរាប់:.....
n. អាហារធ្វើពីប្រេង ខ្លាញ់ ឬប៊ឺរ?	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារ ផ្សេងទៀត ☐ រៀបរាប់:.....
o. ពស់ កង្កែប កណ្តុរ ឬសត្វល្អិត?	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារ ផ្សេងទៀត ☐ រៀបរាប់:.....

p. អាហារមានជាតិផ្អែម (ស្ករ) ដូចជាស្ករគ្រាប់ សុកកូឡា នំ បង្អែម?	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង ☐ 2= ពីរដង 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត ☐ រៀបរាប់:.....

19. កាលពីម្សិលមិញ តើអ្នកបានបរិភោគអាហារពេល ឬអាហារក្រៅពេលប៉ុន្មានដង?	a. អាហារពេល ☐☐ b. អាហារក្រៅពេល ☐☐
20. តើអ្នកតែងតែញ៉ាំធម្មតាដូចនេះ ដែរឬទេ?	1= ចាស→ **សំណួរទី 22** ☐ 2= ទេ
21. ប្រសិនបើមិនធម្មតា តើខុសគ្នាដូចម្តេច? **ចម្លើយតែមួយ**	1. ឈឺ 2. មិនឃ្លាន ☐ 3. គ្មានអាហារគ្រប់គ្រាន់ 4. មានពិធី (ហូបច្រើន ឬផ្សេង) 5. ផ្សេងៗ-បញ្ជាក់: _____
22. អ្នកណាជាអ្នកទទួសខុសត្រូវចម្បងក្នុងការរៀបចំអាហារក្នុងគ្រួសាររបស់អ្នក?	1. ខ្លួនឯង (ស្ត្រី) 5. កូនប្រុស ☐ 2. ប្តី 6. កូនស្រី 3. ឃាយ 4. តា 7. ផ្សេងៗ-បញ្ជាក់:_____

ផ្នែកទី 4 ៖ទឹកត្រី

23. ឥឡូវ ខ្ញុំសូមសួរអ្នកអំពីការបរិភោគទឹកត្រីរបស់អ្នក។ កាលពីមួយអាទិត្យកន្លងមកនេះ តើអ្នកបានបរិភោគទឹកត្រី.....ដែរឬទេ?

ប្រភេទអាហារ	បានបរិភោគកាលពីមួយអាទិត្យកន្លងមក	បើបាន ញឹកញាប់ប៉ុណ្ណា?	បរិមាណក្នុងពេលបរិភោគម្តង (មីលីលីត្រ)	ពិពណ៌នាការបរិភោគ/ការរៀបចំអាហារ
a. ហូបទឹកត្រីផ្ទាល់	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= 1-3ដងក្នុងមួយសប្តាហ៍ ☐ 2= 4-6ដងក្នុងមួយសប្តាហ៍ 3= 7-9ដងក្នុងមួយសប្តាហ៍ 4= ចាប់ពី១0ដងក្នុងមួយសប្តាហ៍		1= ទឹកត្រីតែមួយគត់ដាក់ក្នុងកូនចាន ☐ 2= ទឹកត្រីជាមួយម្ទេស/ខ្ទឹម/ប៊ីចេង/ក្រូចឆ្មារដាក់ក្នុងកូនចាន 3= ផ្សេងៗបញ្ជាក់ .....
b. ទឹកត្រីដាក់ក្នុងសម្ល	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= 1-3ដងក្នុងមួយសប្តាហ៍ ☐ 2= 4-6ដងក្នុងមួយសប្តាហ៍ 3= 7-9ដងក្នុងមួយសប្តាហ៍ 4= ចាប់ពី១0ដងក្នុងមួយសប្តាហ៍		1= ដាក់ក្នុងសម្ល ☐ 2= ដាក់ក្នុងឆា 3= ដាក់ក្នុងខ 3= ផ្សេងៗបញ្ជាក់ .....
c. ផ្សេងៗ-បញ្ជាក់: _____	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= 1-3ដងក្នុងមួយសប្តាហ៍ ☐ 2= 4-6ដងក្នុងមួយសប្តាហ៍ 3= 7-9ដងក្នុងមួយសប្តាហ៍ 4= ចាប់ពី១0ដងក្នុងមួយសប្តាហ៍		

24. កាលពីម្សិលមិញ (ទាំងពេលយប់ និងពេលថ្ងៃ) តើអ្នកបានបរិភោគទឹកត្រី.....ដែរឬទេ?

ប្រភេទអាហារ	បានបរិភោគកាលពីម្សិលមិញ	បើបាន ញឹកញាប់ប៉ុណ្ណា?	បរិមាណក្នុងពេលបរិភោគម្តង (មីលីលីត្រ)	ពិពណ៌នាការបរិភោគ/ការរៀបចំអាហារ
a. ហូបទឹកត្រីផ្ទាល់	១. ចាស ☐ ២. ទេ → ជួរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= ទឹកត្រីតែមួយគត់ដាក់ក្នុងកូនចាន ☐ 2= ទឹកត្រីជាមួយម្ទេស/ខ្ទឹម/បីចេង/ក្រូចឆ្មារដាក់ក្នុងកូនចាន 3= ផ្សេងៗបញ្ជាក់ .....
b. ទឹកត្រីដាក់ក្នុងសម្ល	១. ចាស ☐ ២. ទេ → ជួរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= ដាក់ក្នុងសម្ល ☐ 2= ដាក់ក្នុងឆា 3= ដាក់ក្នុងខ 3= ផ្សេងៗបញ្ជាក់ .....
c. ផ្សេងៗ-បញ្ជាក់: _____	១. ចាស ☐ ២. ទេ → ជួរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		

25. ខាងក្រោមគឺជាសំណួរដែលទាក់ទងទៅនឹងការទិញទឹកត្រី

25.a) តើអ្នកទិញទឹកត្រីនៅផ្សារដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 26** ☐
25.b) តើអ្នកនិយមទិញទឹកត្រីម៉ាកអ្វី?	ម៉ាក:.....ប្រសិនបើមិនអាចឆ្លើយ សូមដាក់កូដ ១=មានម៉ាក-មិនចាំ ២=គ្មានម៉ាក-ទិញរាយ ៣=គ្មានម៉ាក-អ្នកលក់ធ្វើដោយខ្លួនឯង ☐
25.c) តើអ្នកតែងតែទិញទឹកត្រីម៉ាកដដែលៗដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 25e** ☐
25.d) ប្រសិនបើចាស ហេតុអ្វី?	១=ឆ្ងាញ់ ២=តម្លៃថោក ៣=ទម្លាប់ ☐ ៤=មានតែទឹកត្រីនេះ ៥=ផ្សេងៗ.....
25.e) តើអ្នកទិញទឹកត្រីម្តងចំណុះប៉ុន្មាន? (ចំណុះនៅលើដប)	☐☐☐ មីលីលីត្រ
25.f) តើអ្នកអាចប្រើទឹកត្រីនេះបានរយៈពេល ប៉ុន្មានថ្ងៃ?	☐☐ ថ្ងៃ

25.g) តើជាទូទៅទឹកត្រីនេះមានតម្លៃប៉ុន្មាន?	☐☐☐☐ រៀល
25.h) តើអ្នកទុកដាក់ទឹកត្រីយ៉ាងដូចម្តេចនៅក្នុងផ្ទះ?	1. នៅលើធ្នើ នៅស៊ីតុណ្ហភាពធម្មតា (ក្នុងម្លប់) 2. នៅលើធ្នើ នៅស៊ីតុណ្ហភាពធម្មតា (ក្រោមកំដៅថ្ងៃ) 3. ក្នុងទូទឹកកក ឬធុងក្លាសេមានទឹកកក ☐ 4. ផ្សេងៗ៖_____
25.i) តើតាមធម្មតាអ្នករៀបចំទឹកត្រីយ៉ាងដូចម្តេចសម្រាប់បរិភោគនៅក្នុងផ្ទះរបស់អ្នក?	1. ដាក់ក្នុងសម្ល 2. ដាក់ក្នុងឆា 3. ហូបផ្ទាល់ ☐ 4. ដាក់ក្នុងសម្លនិងហូបផ្ទាល់ 5. ដាក់ក្នុងឆានិងហូបផ្ទាល់ 6. ផ្សេងៗ៖_____
26. ឥឡូវខ្ញុំសូមសួរអ្នកអំពីរបៀបដែលគ្រួសារអ្នកបរិភោគទឹកត្រី	
26. a) នៅក្នុងគ្រួសាររបស់អ្នក តើអ្នកណាដែលបរិភោគទឹកត្រីច្រើនជាងគេបំផុត?	1. ខ្លួនឯង (ស្ត្រី) 2. ប្តី ☐ 3. ឃាយ 4. តា 5. ផ្សេងៗ-បញ្ជាក់:_____
26. b) ហេតុអ្វីបានជាគាត់ បរិភោគទឹកត្រីច្រើនជាងគេ?	1. គាត់ឃ្លានជាងគេបំផុត 2. គាត់ចូលចិត្តទឹកត្រីជាងគេបំផុត ☐ 3. គាត់ហូបច្រើនជាងគេ នៅពេលអាហារម្តងៗ 4. ផ្សេងៗ.....
26. c) នៅពេលដែលទឹកត្រីបានដាក់ក្នុងសម្ល តើសមាជិកពេញវ័យគ្រួសារទាំងអស់ហូបបរិមាណដូចគ្នាដែរឬទេ?	1= ចាស→ **សំណួរទី 27** ☐ 2= ទេ 3=មិនប្រើទឹកត្រីពេលធ្វើម្ហូប
26. d) ប្រសិនបើមិនដូច ហេតុអ្វី?	១. អ្នកធ្វើការច្រើនហូបច្រើន ២. ប្តីហូបច្រើន ☐ ៣. អ្នកដែលចូលចិត្ត(សម្ល/ឆា/ខ....)ហូបច្រើនជាងគេ ៤. ផ្សេងៗ-បញ្ជាក់:_____
27.ឥឡូវខ្ញុំសូមសួរពីការគិតរបស់អ្នកស្តីពីផលិតផលបញ្ចូលជីវជាតិ។ ផលិតផលបញ្ចូលជីវជាតិគឺជាអាហារដែលបានបន្ថែមជីវជាតិ និងរ៉ែ ដើម្បីធ្វើអោយប្រសើរឡើងដល់សុខភាព និងការពារជម្ងឺ។ ឧទាហរណ៍អាហារដែលមានបញ្ចូលជីវជាតិ គឺអំបិលបញ្ចូលជាតិអ៊ីយ៉ូត ដែលសម្រាប់ការពារជម្ងឺពកក។	
27. a) ជាទូទៅ តើអ្នកទិញអំបិលអ៊ីយ៉ូដដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 27c)** ☐

27.b) ប្រសិនបើចាស តើហេតុអ្វី? **ពន្យល់ រួចទៅសំណួរ27.d (កុំអានចម្លើយ)**	1. អ្នកដឹងថាវានឹងធ្វើអោយប្រសើរឡើងដល់សុខភាព 2. មានតែអំបិលនេះ ☐ 3. អ្នកដែលអាចជឿជាក់បាន (គ្រូសារ មេភូមិ បុគ្គលិកសុខភាព)បានណែនាំអោយប្រើ 4. អ្នកចូលចិត្តរសជាតិវា 5. ផ្សេងៗ.....
27. c) ប្រសិនបើទេ តើហេតុអ្វី? **(កុំអានចម្លើយ)**	1. វាមានតម្លៃថ្លៃ 2. មិនអាចរកអំបិលអ៊ីយ៉ូតបាន ☐ 3. អ្នកមិនចូលចិត្តរសជាតិ 4. ផ្សេងៗ
27. d)តើអ្នកធ្លាប់ឮអំពីទឹកត្រីមានបញ្ចូលជាតិដែកដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 27h)** ☐
27. e) ប្រសិនបើធ្លាប់ តើឮពីកន្លែងណា?	១. ប្រពន្ធ័ផ្សព្វផ្សាយ(ទូរទស្សន៍/វិទ្យុ/កាសែត..) ☐ ២.ផ្ទាំងរូបភាពក្នុងភូមិ ៣.អ្នកដែលអាចជឿជាក់បាន (គ្រូសារ មេភូមិ បុគ្គលិកសុខភាព)បានណែនាំ ៤.ផ្សេងៗ-បញ្ជាក់:_____
27. f) តើអ្នកធ្លាប់ទិញទឹកត្រីបញ្ចូលជាតិដែកដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 27h)** ☐
27. g) ប្រសិនបើធ្លាប់ ហេតុអ្វី? (កុំអានចម្លើយ)	1. អ្នកដឹងថាវានឹងធ្វើអោយប្រសើរឡើងដល់សុខភាព 2. មានតែទឹកត្រីនេះ ☐ 3. អ្នកដែលអាចជឿជាក់បាន (គ្រូសារ មេភូមិ បុគ្គលិកសុខភាព)បានណែនាំអោយប្រើ 4. អ្នកចូលចិត្តរសជាតិវា 5. ផ្សេងៗ.....
27. h) ប្រសិនបើទឹកត្រីមានបញ្ចូលទាំងជាតិដែក និងជីវជាតិដែលអាចធ្វើអោយប្រសើរឡើងដល់សុខភាពអ្នក (ជីវជាតិ B1) តើអ្នកនឹងទិញវាដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 27j)** ☐
27. i) ប្រសិនបើទិញ តើហេតុអ្វី? **ពន្យល់ រួចទៅសំណួរ27.k)**	១.ធ្វើអោយសុខភាពប្រសើរឡើង ២.ណែនាំដោយអ្នកដែលអាចជឿជាក់បាន (គ្រូសារ មេភូមិ បុគ្គលិកសុខភាព)បានណែនាំអោយប្រើ ៣.ផលិតផលចាត់ទុកថាមានសុវត្ថភាព ☐ ៤.មានអ្នកភូមិទិញវា ៥.ផ្សេងៗ-បញ្ជាក់:_____

27. j) ប្រសិនបើមិនទិញ ហេតុអ្វី?**ពន្យល់រួច សូមទៅសំណួរ28**	
27. k) តើអ្នកនឹងចំណាយលុយលើសប៉ុន្មានដើម្បីទិញផលិតផលនេះ បើប្រៀបធៀបទៅនឹងទឹកត្រីដែលអ្នកតែងតែទិញ?	_____រៀល 1.មិនទិញទឹកត្រី

ផ្នែកទី៥៖ ចំណេះដឹងស្តីពីកង្វះជីវជាតិB1 និងជម្ងឺបេរីបេរី	
28. តើអ្នកធ្លាប់ឮអំពីជីវជាតិB1 ឬហ្សាមីន ដែរឬទេ?	1= ចាស 2= ទេ ☐
29. តើអ្នកធ្លាប់ឮអំពីបញ្ហាកង្វះជីវជាតិB1 ឬជំងឺបេរីបេរីដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 33** ☐
30. តើអ្នកដឹងអំពី អាការៈរោគនៃបញ្ហាកង្វះជីវជាតិB1 ឬជំងឺបេរីបេរី ចំពោះទារកអាយុតិចជាង៦ខែដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 33** ☐
31. តើអាការៈរោគនៃបញ្ហាកង្វះជីវជាតិB1 ឬជំងឺបេរីបេរីចំពោះទារកអាយុតិចជាង៦ខែមានអ្វីខ្លះ?	.....
32. តើអ្នកព្យាបាលបញ្ហាកង្វះជីវជាតិB1 ឬជំងឺបេរីបេរីចំពោះទារកអាយុតិចជាង៦ខែ ដោយរបៀបណា?	.....
33. តើទារកគួរបៅតែ**<u>ទឹកដោះម្តាយមួយតែមុខគត់</u>**រហូតដល់អាយុប៉ុន្មាន (បំបៅតែទឹកដោះម្តាយតែមួយមុខគត់ គ្មានទឹក ទឹកដូង ទឹកដោះគោ ឬអាហារផ្សេងៗទៀត)?	.....**ខែ** **88= មិនដឹង**
34. តើកុមារគួរតែចាប់ផ្តើមទទួលអាហារបន្ថែមក្រៅពីទឹកដោះ ម្តាយ នៅអាយុប៉ុន្មាន? (អាហារដែលផ្តល់ឱ្យកុមារ បន្ថែមទៅលើទឹកដោះ)	.....ខែ 88=មិនដឹង
35. តើកុមារគួរតែ**បន្ត**បំបៅដោយទឹកដោះម្តាយ ជាមួយនឹងការផ្តល់អាហារផ្សេងៗទៀតដល់អាយុប៉ុន្មាន?	.....ខែ 88=មិនដឹង
36. តើអ្វីខ្លះជាអាហារដំបូង ដែលកុមារគួរតែបរិភោគក្រៅពីទឹកដោះម្តាយ?	1. _____ 2. _____ 3. _____
37. តើកុមារគួរតែចាប់ផ្តើមបរិភោគអាហារគ្រួសារនៅអាយុប៉ុន្មាន?	.....ខែ 88=មិនដឹង

ផ្នែកទី 6 ៖ ការវាស់កម្ពស់ និងថ្លឹងទម្ងន់	
ការវាស់កម្ពស់ និងថ្លឹងទម្ងន់ អ្នកចូលរួមទាំងអស់ និងកូនពៅគេបង្អស់អាយុពី១២ខែដល់៥៩ខែ	
38. កម្ពស់របស់អ្នកចូលរួម	១) ☐☐☐.☐ ស.ម ២) ☐☐☐.☐ ស.ម ៣) ☐☐☐.☐ ស.ម
39. ការថ្លឹងទម្ងន់របស់អ្នកចូលរួម	១) ☐☐.☐ គ.ក ២) ☐☐.☐ គ.ក ៣) ☐☐.☐ គ.ក
40. កម្ពស់/ប្រវែងកូនពៅគេបង្អស់អាយុពី១២ដល់៥៩ខែ	១) ☐☐☐.☐ ស.ម ២) ☐☐☐.☐ ស.ម ៣) ☐☐☐.☐ ស.ម
41. ទម្ងន់កូនពៅគេបង្អស់អាយុពី១២ដល់៥៩ខែ	១) ☐☐.☐ គ.ក ២) ☐☐.☐ គ.ក ៣) ☐☐.☐ គ.ក
42. រង្វាស់ជុំវិញពាក់កណ្តាលដើមដៃកូនពៅគេបង្អស់អាយុពី១២ដល់៥៩ខែ **ចំណាំ: បើតូចជាង១១.៥ស.ម សូមបញ្ជូនទៅមណ្ឌលសុខភាព**	១) ☐☐.☐ ស.ម ២) ☐☐.☐ ស.ម ៣) ☐☐.☐ ស.ម

a place of mind

ENDLINE QUESTIONNAIRE
WOMEN OF CHILDBEARING AGE COHORT
Thiamin fortified fish sauce as a means of combating infantile beriberi in rural Cambodia

CONFIDENTIAL
All information collected in this survey is strictly confidential and will be used for statistical purposes only.

IDENTIFICATION INFORMATION	
Geographic Identification	**Interviewer Record**
Province: _____PREY VENG_____ District: _____ Commune: _____ Village: _____ Subject ID: __ __ __ __ __	Interviewer Name: _____ Signature: _____ Remarks:
Date of Interview: (DD/MM/YYYY) ___ ___ / ___ ___ / ___ ___ ___ ___	

MODULE 1: PARTICIPANT INFORMATION	
1. How many people currently live in your household (defined as eating from the same pot each day)?	_____ people
2. Is the child >12 months we measured at the beginning of the study a girl or boy?	1. Girl 2. Boy ____
3. Are you currently pregnant?	1. Yes **2. No → code, then proceed to Q5** ____
4. How many months pregnant are you?	_____ months
5. Are you currently breastfeeding?	1. Yes 2. **No → code, then proceed to Q8** ____

6. How old is the child you are currently breastfeeding?	_____ months
7. Are you currently exclusively breastfeeding this child (feeding only breast milk, no water, coconut water, rice, or other foods)?	1. Yes 2. No ____
8. Under what conditions is fish sauce stored in your home?	1. on a shelf at room temperature (in the shade) 2. on a shelf at room temperature (in the sun) 3. in a refrigerator, or in a cool box with ice 4. other - specify: _____ _____
9. During this study, did you share or sell any of the fish sauce provided to you?	1. Yes **2. No → code, then proceed to Q11** ____
10. If yes, who did you sell or share this fish sauce with?	1. family/relative living outside the household 2. neighbors or friends 3. other: _____ _____
11. During the past 6 months, how many bottles of fish sauce did your household typically consume in a two week period?	_____ . _____ bottles
12. During the past 6 months, did you leave your village for longer than 2 consecutive weeks? (For example, to work in another province, to live with relatives, etc)	1. Yes **2. No → code, then proceed to Q14** ____
13. If yes, how many months (total) were you living away from your home in the past six months?	_____ . _____ months

MODULE 2: FOOD INTAKE

14. I would like to ask you about the foods and drinks that you may have consumed **yesterday** during the day or night. I want to know how often you ate the food, approximately how much of the food you ate in a typical serving, and how it was consumed.

Food Type	**Consumed yesterday**	**If yes, how often?**	**Amount per typical serving (g or mL)**	**Consumed alone, or with other foods?**
a) White Rice, and white rice borbor	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
b) Bread, rice, noodles, porridge, or other foods made from grains? (**Other than white rice**.)	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____

c) Pumpkin, carrots, squash, or sweet potatoes that are yellow or orange inside?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
d) White potatoes, white yams, manioc, cassava, or any other foods made from roots?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
e) Dark leafy green vegetables (eg. kang kong)	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
f) Ripe mangoes, papayas or any other yellow or orange fruits?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
g) Other fruits or vegetables?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
h) Liver, kidney, heart, or other organ meats?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
i) Meat, such as beef, pork, lamb, goat, chicken, or duck?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
j) Eggs?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
k) Fresh or dried fish and shellfish (including snails, crab, squid)?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
l) Foods made from beans, peas, lentils, or nuts?	1. Yes 2. No → code, then proceed to next row	1. Once 2. Twice 3. Three times 4. >3 times		1. Consumed alone 2. Consumed with other foods; describe:

	_____	_____		_____
m) Milk, cheese or other foods made from milk?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
n) Foods made with oil, fat, or butter?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
o)Snake, frog, rats, or insects?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
p) Sugary foods such as pastry, cakes, chocolates, sweets, or candies?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____

15. How many meals and snacks did you consume yesterday?	_____ meals, **and** _____ snacks
16. Was yesterday's food intake typical/usual for you?	**1. Yes → code, then proceed to Q18** 2. No ____
17. If no, why was it not typical/usual? CHECK ALL THAT APPLY.	1. I was ill ____ 2. I was not hungry ____ 3. There was not enough food ____ 4. It was a celebration (ate more or differently) ____ 5. Other – specify:_____ ____
18. Who is primarily responsible for food preparation in your household?	1. mother 2. father 3. grandmother 4. grandfather 5. male children ____ 6. female children 7. other – specify:_____

MODULE 3: FISH SAUCE

19. Now I would like to ask you about your fish sauce consumption. During the **past week**, did you consume fish sauce …

Food Type	**Consumed in last week**	**If yes, how often?**	**Amount of fish sauce per typical serving (mL)**	**Describe consumption/ food preparation**
Fish sauce as a condiment	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____		1. fish sauce **alone** in small bowl 2. fish sauce in small bowl with garlic/chillies/MSG/lime/lemon 3. other: _____ _____
Fish sauce, in the common pot	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____		1. in soup 2. in sir fry 3. in Khor 4. other: _____ _____
Teuk Trey Ph'aem, or Teuk Trey Koh Kong	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____		1. Teuk Trey Ph'aem 2. Teuk Trey Koh Kong 3. other:_____ _____
Fish sauce with green mango	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____		
Fish sauce with tamarind	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____		1. ripe tamarind 2. young tamarind 3. other: _____ _____
Teuk Kroeung	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____		
Other – specify: _____	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____		

20. During the **past day** (yesterday, during the day and at night), did you consume fish sauce …

Food Type	**Consumed yesterday**	**If yes, how often?**	**Amount of fish sauce per typical serving**	**Describe consumption/ food preparation**

			(mL)	
Fish sauce as a condiment	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. fish sauce alone in small bowl 2. fish sauce in small bowl with garlic/chillies/MSG/lime/lemon 3. other: _____ _____
Fish sauce, in the common pot	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. in soup 2. in sir fry 3. in Khor 4. other: _____ _____
Teuk Trey Ph'aem, or Teuk Trey Koh Kong	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Teuk Trey Ph'aem 2. Teuk Trey Koh Kong 3. other:_____ _____
Fish sauce with green mango	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		
Fish sauce with tamarind	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. ripe tamarind 2. young tamarind 3. other: _____ _____
Teuk Kroeung	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		
Other – specify: _____	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		

21. Now I would like to ask you about your household's fish sauce consumption patterns over the study period (last 6 months).

21. a) During the study period (last 6 months), did your household's fish sauce consumption change from usual? (Compared to before the study)	1. Yes 2. **No → code, and proceed to Q22** _____
21. b) If yes, has it increased or decreased slightly or a lot?	1. Increased slightly 2. Increased a lot

	3. Decreased slightly 4. Decreased a lot ____
21. c) Why did it change?	1. Fish sauce was provided for free 2. Fish sauce tasted delicious 3. Fish sauce did **not** taste delicious 4. Other – specify:_____ ____
22. I would now like to ask you about your perceptions of the fish sauce you have been consuming over the study period (last 6 months).	
22. a) Did you like the taste of the fish sauce you consumed throughout the study period?	1. Yes 2. **No → code, and proceed to Q22. c)** _____
22.b) If yes, why? **Explain, then proceed to Q22d)**	1. Tasted delicious 2. Tasted like the fish sauce I normally buy 3. Tasted like the fish sauce I normally make 4. Other – specify:_____ ____
22. c) If no, why?	1. Tasted too salty 2. Tasted different from my usual fish sauce 3. Tasted like medicine 4. Other – specify:_____ ____
22. d) Was the colour of the fish sauce acceptable?	**1. Yes → code, and proceed to Q22. f)** 2. No _____
22. e) If no, why not?	1. Too dark 2. Too light 3. Other – specify:_____ ____
22. f) In the future, if there were the possibility to purchase the study fish sauce in your village, would you choose purchase it?	1. Yes 2. No → **code, and proceed to Q22. i)** _____
22. g) If yes, why?	1. Tasted delicious 2. I think it improves my family's health 3. Other – specify:_____ ____
22. h) How much would you be willing to pay for one bottle (750 mL) of this study fish sauce?	_____ Riel → **write, and proceed to Q23**
22. i) If no, why not?	1. Tasted too salty 2. Tasted different from my usual fish sauce 3. Tasted like medicine 4. Other – specify:_____ ____
23. a) In your household, who consumes the most fish sauce?	1. mother 2. father 3. grandmother 4. grandfather 5. Other: _____ _____
23. b) Why does this person consume the most	1. they have the largest appetite

fish sauce?	2. they prefer fish sauce the most 3. they are fed the largest portion of each meal 4. Other: _____ _____
23. c) When fish sauce is consumed from the common pot, do all members of your household consume the same amount?	1. **Yes → code, and proceed to Q24** 2. No 3. fish sauce not used in common pot → **code, and proceed to Q24** _____
23. d) If no, why?	1. person who works the most eats more 2. husband eats more 3. person who prefers the food from the common pot the most eats more 4. other - specify: _____ _____
24. When you purchase fish sauce at market, how much do you usually pay for one 750 mL bottle?	_____ Riel or **88** if do not purchase fish sauce
25. I would now like to ask your opinion about fortified products. A fortified product is a food that has added vitamins or minerals to improve health and prevent disease. One example of a fortified food is iodized salt, which is used to prevent goiters.	
25. a) Have you heard of iron-fortified fish sauce?	1. Yes 2. **No → code, and proceed to Q25f)** _____
25. b) If yes, from where?	1. at the market, or from sellers 2. from a healthcare provider (VHV, nurse, doctor, midwife etc) 3. from a trusted person, such as the village chief 4. from a friend or family member 5. Other: _____ _____
25. c) Have you purchased iron-fortified fish sauce?	1. Yes 2. **No → code, and proceed to Q25e)** _____
25. d) If yes, why? **Explain, then proceed to Q25.f)**	1. because it will improve health 2. because it is the only fish sauce available 3. because a trusted person (family member, village chief, health professional) recommended it 4. because you prefer the taste 5. Other: _____ _____
25. e) If no, why?	1. because it is expensive 2. because it is not available 3. because you do not like the taste 4. Because you do not like the colour 5. Other: _____ _____
25. f) If a fish sauce became available that	1. Yes

contained both iron and a vitamin (vitamin B_1), that could improve your health would you purchase this product?	2. **No → code, and proceed to 25h)** _____
25. g) If yes, why? **Explain, then proceed to Q25i)**	1. it could improve health 2. It may be recommended by a trusted person (family member, village chief, health professional) 3. it is deemed safer and of higher quality because it's likely more carefully regulated 4. other people may purchase it 5. other: _____ _____
25. h) If no, why? **Explain, then proceed to Q26**	1. it will likely be more expensive 2. she **likes to** make fish sauce herself 3. she **must** make fish sauce herself because she doesn't have money to buy fish sauce 4. other: _____ _____
25. i) How much **more** money would you be willing to pay for this product (as compared to what you usually spend on fish sauce)?	_____ Riel

MODULE 4: KNOWLEDGE OF THIAMIN DEFICIENCY, BERIBERI, AND INFANT AND YOUNG CHILD FEEDING (IYCF)	
26. Have you ever heard of vitamin B_1, also known as thiamin?	1. Yes 2. No _____
27. Have you ever heard of vitamin B_1 (thiamin) deficiency, or beriberi?	1. Yes 2. **No → code, and proceed to Q33** _____
28. Do you know any symptoms of vitamin B_1 (thiamin) deficiency or beriberi in infants less than 6 months old?	1. Yes 2. **No → code, and proceed to Q33** _____
29. What are the symptoms of vitamin B_1 (thiamin) deficiency or beriberi in **infants less than 6 months old**? CHECK ALL THAT APPLY	a. rapid breathing _____ b. rapid heart rate _____ c. edema _____ d. vomiting _____ e. little urine _____ f. convulsions _____ g. distinctive cry with no sound _____ h. loss of appetite _____ i. other: _____ _____
30. How do you prevent or treat vitamin B_1 (thiamin) deficiency or beriberi in **infants less than 6 months old**? CHECK ALL THAT APPLY	a. mother should eat foods rich in thiamin _____ b. mother should eat a thiamin-fortified food such as fish sauce _____ c. mother should take a thiamin supplement (pill) _____ d. baby should eat foods rich in thiamin _____ e. baby should eat a thiamin-fortified food such as fish sauce _____ f. baby should take a thiamin supplement (pill) _____ g. other: _____ _____
31. Can you name some foods that are good sources of thiamin?	1. Yes 2. **No → code, and proceed to Q33**

	_____
32. If yes, please name some foods high in thiamin. CHECK ALL THAT APPLY	a. **brown** rice _____ b. legumes, like beans and peas _____ c. pork _____ d. organ meats _____ e. soybeans, tofu, and/or soy products _____ f. Other: _____ _____
33. Until what age should infants be **exclusively** breastfed (fed **only** breast milk, not water, coconut water, rice, or any other foods)?	_____ months 88 = unknown
34. At what age should children start receiving complimentary foods (foods that are provided to children in addition to breast milk)?	_____ months 88 = unknown
35. Until what age should children **continue** to breastfeed while also eating other foods?	_____ months 88 = unknown
36. What are the first foods a child should eat, other than breast milk? CHECK ALL THAT APPLY	a. tinned porridge _____ b. plain porridge _____ c. enriched borbor _____ d. white rice _____ e. steamed rice with salt/meat/fish sauce/soup/other _____ f. mushed rice with salt/meat/fish sauce/soup/other _____ g. yellow or orange fruit or vegetables _____ h. egg _____ i. other: _____ _____
37. When should a child start eating foods from the family pot?	_____ months 88 = unknown

MODULE 5: PERCIEVED HEALTH BENEFITS	
33. Since the beginning of the study (last 6 months) have you seen a change in energy or activity levels of yourself or your child?	1. Yes 2. No **No → code, then proceed to Q49** _____
34. If yes, please describe regarding yourself.	
35. If yes, please describe regarding your child.	
36. Since the beginning of the study (last 6 months) have you seen a change in your health or the health of your child?	1. Yes 2. **No → code, then proceed to Q41** _____
37. If yes, please describe regarding yourself.	
38. If yes, please describe regarding your child.	

Thank you so much for your time!

បញ្ជីសំណួរការអង្កេតបញ្ចប់

សម្រាប់ស្ត្រីក្នុងវ័យបន្តពូជ

ទឹកត្រីបញ្ចុលជីវជាតិB1 ជាមធ្យោបាយក្នុងការទប់ស្កាត់ជម្ងឺបេរីបេរីចំពោះទារក នៅតាមជនបទប្រទេសកម្ពុជា

ការសំងាត់
រាល់ព័ត៌មានដែលប្រមូលបាននៅក្នុងការសិក្សាស្រាវជ្រាវនេះនឹងត្រូវបានរក្សាជាការសំងាត់ និងប្រើប្រាស់ក្នុងគោល បំណងបែបស្ថិតិប៉ុណ្ណោះ ។

ព័ត៌មានកំណត់សំគាល់	
កំណត់សំគាល់ភូមិសាស្ត្រ	**កំណត់សំគាល់អ្នកសម្ភាសន៍**
ខេត្ត: ព្រៃវែង ស្រុក: ..... ឃុំ: ..... ភូមិ៖ ..... លេខសំគាល់សំណាក: ☐☐☐☐☐	អ្នកសម្ភាសន៍ ឈ្មោះ ..... ហត្ថលេខា: ..... កំណត់សម្គាល់ .....
កាលបរិច្ឆេទការសម្ភាសន៍: (ថ្ងៃ /ខែ /ឆ្នាំ) __/__/____	

ផ្នែកទី 1 ៖ ព័ត៌មានអ្នកចូលរួម	
1. បច្ចុប្បន្ននេះ តើមានមនុស្សប៉ុន្មាននាក់រស់នៅក្នុងផ្ទះរបស់អ្នក? (រាប់អ្នកដែលហូបបាយជាមួយគ្នា រាល់ថ្ងៃ)	☐☐ នាក់
2. តើកុមារអាយុច្រើនជាង១២ខែ ដែលយើងបានវាស់ថ្លឹង នៅពេលចាប់ផ្តើមការសិក្សាជា ស្រីឬប្រុស?	1= ស្រី ☐ 2= ប្រុស
3. បច្ចុប្បន្ននេះ តើអ្នកកំពុងមានផ្ទៃពោះដែរឬទេ?	1= ចាស 2= ទេ → **រំលងទៅសំណួរទី5** ☐
4. តើអ្នកមានផ្ទៃពោះប៉ុន្មានខែហើយ?	☐☐ ខែ
5. បច្ចុប្បន្ននេះ តើអ្នកកំពុងបំបៅកូនដោយទឹកដោះម្តាយដែរឬទេ?	1= ចាស 2= ទេ → **រំលងទៅសំណួរទី8** ☐

6. តើកូនដែលអ្នកកំពុងបំបៅដោះនោះអាយុប៉ុន្មានខែ?	☐☐ ខែ
7. បច្ចុប្បន្ននេះ តើអ្នកបំបៅកូននោះដោយទឹកដោះម្តាយតែមួយមុខគត់ (ទឹកដោះម្តាយតែមួយមុខគត់ គ្មានអោយទឹក ទឹកដូង បាយ ឬអាហារដទៃទៀត)ដែរឬទេ?	1= ចាស 2= ទេ ☐
8. តើទឹកត្រីទុកដាក់យ៉ាងដូចម្តេច នៅក្នុងផ្ទះរបស់អ្នក?	1= នៅលើធ្នើ ក្នុងសីតុណ្ហភាពធម្មតា (ក្នុងម្លប់) 2= នៅលើធ្នើ ក្នុងសីតុណ្ហភាពធម្មតា (ត្រូវកំដៅថ្ងៃ) 3= ក្នុងទូរទឹកកក ឬក្នុងធុងដែលមានទឹកកក ☐ 4= ផ្សេងៗ- បញ្ជាក់.....
9. ក្នុងអំឡុងពេលការសិក្សានេះ តើអ្នកបានចែករំលែក ឬលក់ទឹកត្រីដែលគម្រោងបានចែកអោយអ្នកដែរឬទេ?	1= ចាស 2= ទេ → **រំលងទៅសំណួរទី11** ☐
10. ប្រសិនបើចាស តើអ្នកបានលក់ឬចែកទឹកត្រីនោះទៅអ្នកណា?	1= សាច់ញាតិ/បងប្អូនដែលរស់នៅផ្ទះផ្សេង ☐ 2= អ្នកជិតខាង ឬមិត្តភក្តិ 3= ផ្សេងៗ:.....
11. ក្នុងអំឡុងពេល៦ខែកន្លងមកនេះ តើជាធម្មតាគ្រួសាររបស់អ្នកបានបរិភោគទឹកត្រីអស់ប៉ុន្មានដប សម្រាប់រយៈពេលពីរសប្តាហ៍?	☐.☐ ដប
12. ក្នុងអំឡុងពេល៦ខែកន្លងមកនេះ តើអ្នកបានចាកចេញពីភូមិយូរជាងពីរសប្តាហ៍ជាប់គ្នាដែរឬទេ? (ឧ. ទៅធ្វើការនៅខេត្តផ្សេងទៅរស់នៅជាមួយសាច់ញាតិ។ល។)	1= ចាស 2= ទេ → **រំលងទៅសំណួរទី14** ☐
13. ប្រសិនបើចាស ក្នុងអំឡុងពេល៦ខែកន្លងមកនេះ តើអ្នករស់នៅឆ្ងាយពីផ្ទះរយៈពេលសរុបប៉ុន្មានខែ ?	☐.☐ ខែ

ផ្នែកទី 2: ការបរិភោគអាហារ

14.ខ្ញុំសូមសួរអ្នកអំពីអាហារ និងភេសជ្ជៈដែលអ្នកបានបរិភោគ **កាលពីម្សិលមិញ** នៅពេលថ្ងៃ ឬពេលយប់។ ខ្ញុំចង់ដឹងពីចំនួនដង បរិមាណអាហារ និងរបៀបដែលអ្នកបានបរិភោគ។

ប្រភេទអាហារ	**បានបរិភោគកាលពីម្សិលមិញ**	**បើបាន ញឹកញាប់ប៉ុណ្ណា?**	**បរិមាណក្នុងពេលបរិភោគម្តង (ក្រាម ឬមីលីលីត្រ)**	**បរិភោគតែមួយមុខ ឬលាយជាមួយអាហារផ្សេងទៀត?**
a) បាយ និងបបរអង្ករសម្រិត	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
b) នំប៉័ង/បាយ/មី/បបរ ឬអាហារធ្វើពីគ្រាប់ធញ្ញជាតិផ្សេងទៀត? (ក្រៅពីអង្ករសម្រិត)	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....

c) ល្ពៅ ការ៉ុត ឬដំឡូងជ្វាសាច់ពណ៌លឿង ឬពណ៌ទឹកក្រូច	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
d) ដំឡូងជ្វាសាច់ពណ៌ស ដំឡូងមី ត្រាវ សាគូ ឬអាហារផ្សេងៗធ្វើពីមើម	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
e) បន្លែស្លឹកពណ៌បៃតងចាស់ (ឧ. ត្រកួន)	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
f) ស្វាយទុំ ល្អុងទុំ ឬផ្លែឈើពណ៌លឿងទុំដទៃទៀត?	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
g) បន្លែ ឬផ្លែឈើដទៃទៀត?	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
h) ថ្លើម ក្រលៀន បេះដូង ឬគ្រឿងក្នុងដទៃទៀត?	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
i) សាច់សត្វ ដូចជាសាច់គោ សាច់ជ្រូក សាច់ចៀម សាច់ពពែ សាច់មាន់ សាច់ទា?	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
j) ស៊ុត?	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
k) ត្រីស្រស់ ឬត្រីងៀត ខ្យង ខ្ចៅ ក្តាម មឹក?	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
l) អាហារធ្វើពីសណ្តែក ឬសណ្តែកបារាំងឬសណ្តែកដី	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....

m) ទឹកដោះគោ ឈីស ឬអាហារធ្វើពីទឹកដោះគោ?	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
n) អាហារធ្វើពីប្រេង ខ្លាញ់ ឬប៊ឺរ?	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
o) ពស់ កង្កែប កណ្តុរ ឬសត្វល្អិត?	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
p) អាហារមានជាតិផ្អែម (ស្ករ) ដូចជាស្ករគ្រាប់ សុកក្លូឡា នំ បង្អែម?	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....

15. កាលពីម្សិលមិញ តើអ្នកបានបរិភោគអាហារពេល ឬអាហារក្រៅពេលប៉ុន្មានដង?	អាហារពេល ☐☐ អាហារក្រៅពេល ☐☐
16. តើអ្នកតែងតែញ៉ាំធម្មតាដូចនេះ ដែរឬទេ?	1= ចាស→ **សំណួរទី 18** ☐ 2= ទេ
17. ប្រសិនបើមិនធម្មតា តើខុសគ្នាដូចម្តេច? **សូមគូសយកចម្លើយដែលបានឆ្លើយទាំងអស់** **កូដ 0=ទេ 1=ចាស**	1. ឈឺ ☐ 2. មិនឃ្លាន ☐ 3. គ្មានអាហារគ្រប់គ្រាន់ ☐ 4. មានពិធី (ហូបច្រើន ឬផ្សេង) ☐ 5. ផ្សេងៗ-បញ្ជាក់: _____
18. អ្នកណាជាអ្នកទទួសខុសត្រូវចម្បងក្នុងការរៀបចំអាហារក្នុងគ្រួសាររបស់អ្នក?	1. ម្តាយកុមារ 2. ឪពុកកុមារ ☐ 3. យាយកុមារ 4. តាកុមារ 5. កូនប្រុស 6. កូនស្រី 7. ផ្សេងៗ-បញ្ជាក់:_____

ផ្នែកទី 3 ៖ទឹកត្រី

19. ឥឡូវ ខ្ញុំសូមសួរអ្នកអំពីការបរិភោគទឹកត្រីរបស់អ្នក។ កាលពីមួយអាទិត្យកន្លងមកនេះ តើអ្នកបានបរិភោគទឹកត្រី..... ដែរឬទេ?

ប្រភេទអាហារ	បានបរិភោគកាលពីមួយអាទិត្យកន្លងមក	បើបាន ញឹកញាប់ប៉ុណ្ណា?	បរិមាណទឹកត្រី ក្នុងពេលបរិភោគម្តង (មីលីលីត្រ)	ពិពណ៌នាការបរិភោគ/ការរៀបចំអាហារ
ហូបទឹកត្រីផ្ទាល់	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= 1-3ដងក្នុងមួយសប្តាហ៍ 2= 4-6ដងក្នុងមួយសប្តាហ៍ ☐ 3= 7-9ដងក្នុងមួយសប្តាហ៍ 4= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍		1.ទឹកត្រីសុទ្ធ 2.ទឹកត្រីលាយជាមួយម្ទេសខ្ទឹមស ប៊ីចេង ក្រូចឆ្មារ 3.ផ្សេងៗ.....
ទឹកត្រីដាក់ក្នុងម្ហូប	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= 1-3ដងក្នុងមួយសប្តាហ៍ 2= 4-6ដងក្នុងមួយសប្តាហ៍ ☐ 3= 7-9ដងក្នុងមួយសប្តាហ៍ 4= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍		1. ដាក់ក្នុងសម្ល 2. ដាក់ក្នុងឆា 3. ដាក់ក្នុងខ 4. ផ្សេងៗបញ្ជាក់.....
ទឹកត្រីផ្អែម ឬ ទឹកត្រីកោះកុង	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= 1-3ដងក្នុងមួយសប្តាហ៍ 2= 4-6ដងក្នុងមួយសប្តាហ៍ ☐ 3= 7-9ដងក្នុងមួយសប្តាហ៍ 4= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍		1= ទឹកត្រីផ្អែម 2= ទឹកត្រីកោះកុង 3=ផ្សេងៗបញ្ជាក់.....
ទឹកត្រីជាមួយស្វាយ	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= 1-3ដងក្នុងមួយសប្តាហ៍ 2= 4-6ដងក្នុងមួយសប្តាហ៍ ☐ 3= 7-9ដងក្នុងមួយសប្តាហ៍ 4= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍		
ទឹកត្រីជាមួយអំពិល	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= 1-3ដងក្នុងមួយសប្តាហ៍ 2= 4-6ដងក្នុងមួយសប្តាហ៍ ☐ 3= 7-9ដងក្នុងមួយសប្តាហ៍ 4= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍		1= អំពិលទុំ 2= ទំពិលខ្ចី 3=ផ្សេងៗបញ្ជាក់.....
ទឹកគ្រឿង	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= 1-3ដងក្នុងមួយសប្តាហ៍ 2= 4-6ដងក្នុងមួយសប្តាហ៍ ☐ 3= 7-9ដងក្នុងមួយសប្តាហ៍ 4= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍		
ផ្សេងៗ-បញ្ជាក់: _____	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= 1-3ដងក្នុងមួយសប្តាហ៍ 2= 4-6ដងក្នុងមួយសប្តាហ៍ ☐ 3= 7-9ដងក្នុងមួយសប្តាហ៍ 4= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍		

20. កាលពីម្សិលមិញ (ទាំងពេលយប់ និងពេលថ្ងៃ) តើអ្នកបានបរិភោគទឹកត្រី.....ដែរឬទេ?

ប្រភេទអាហារ	បានបរិភោគកាលពីម្សិលមិញ	បើបាន ញឹកញាប់ប៉ុណ្ណា?	បរិមាណទឹកត្រី ក្នុងពេលបរិភោគម្តង (មីលីលីត្រ)	ពិពណ៌នាការបរិភោគ/ ការរៀបចំអាហារ
ហូបទឹកត្រីផ្ទាល់	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង 3= បីដង 4= ច្រើនជាងបីដង ☐		1. ទឹកត្រីសុទ្ធ 2. ទឹកត្រីលាយជាមួយម្ទេស ខ្ទឹមស ប៊ីចេង ក្រូចឆ្មារ 3. ផ្សេងៗ.....
ទឹកត្រីដាក់ក្នុងម្ហូប	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង 3= បីដង 4= ច្រើនជាងបីដង ☐		1. ដាក់ក្នុងសម្ល 2. ដាក់ក្នុងឆា 3. ដាក់ក្នុងខ 4. ផ្សេងៗបញ្ជាក់.....
ទឹកត្រីផ្អែម ឬ ទឹកត្រីកោះកុង	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង 3= បីដង 4= ច្រើនជាងបីដង ☐		1= ទឹកត្រីផ្អែម 2= ទឹកត្រីកោះកុង 3=ផ្សេងៗបញ្ជាក់.....
ទឹកត្រីជាមួយស្វាយខ្ចី	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង 3= បីដង 4= ច្រើនជាងបីដង ☐		
ទឹកត្រីជាមួយអំពិល	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង 3= បីដង 4= ច្រើនជាងបីដង ☐		1= អំពិលទុំ 2= ទំពិលខ្ចី 3=ផ្សេងៗបញ្ជាក់.....
ទឹកគ្រឿង	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង 3= បីដង 4= ច្រើនជាងបីដង ☐		

21 ឥឡូវនេះ ខ្ញុំសូមសួរអ្នកអំពីការបរិភោគទឹកត្រីនៅក្នុងគ្រួសាររបស់អ្នក ក្នុងអំឡុងពេលការសិក្សា (៦ខែកន្លងមក)

21. a) ក្នុងអំឡុងពេលការសិក្សា (៦ខែកន្លងមក)តើការបរិភោគទឹកត្រីក្នុងគ្រួសារអ្នក មានការផ្លាស់ប្តូរខុសពីធម្មតាដែរឬទេ? (ប្រៀបធៀបមុនពេលចូលរួមគម្រោង)	1= ចាស 2= ទេ → **សំណួរទី 22** ☐
21. b) ប្រសិនបើចាស តើវាកើនឡើង ឬថយចុះ បន្តិចបន្តួច ឬច្រើន?	1= កើនឡើងបន្តិចបន្តួច 2= កើនឡើងច្រើន 3= ថយចុះតិចតួច 4= ថយចុះច្រើន ☐

21. c) ហេតុអ្វីបានជាវាផ្លាស់ប្តូរ?	1= បានទទួលទឹកត្រីដោយឥតគិតថ្លៃ 2= ទឹកត្រីមានរសជាតិឆ្ងាញ់ ☐ 3= ទឹកត្រីមិនឆ្ងាញ់ 4= ផ្សេងៗ បញ្ជាក់៖.....
22 ឥឡូវនេះ ខ្ញុំសូមសួរអ្នកអំពីគំនិតរបស់អ្នកស្តីពីទឹកត្រី ដែលអ្នកបានបរិភោគក្នុងអំឡុងពេលការសិក្សា (៦ខែកន្លងមក)	
22. a) តើអ្នកចូលចិត្តរសជាតិទឹកត្រីដែលអ្នកបានបរិភោគ ក្នុងអំឡុងពេលសិក្សាដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 22. c)** ☐
22 b) ប្រសិនបើចាស ហេតុអ្វី? **ពន្យល់ រួចទៅសំណួរ22. d)**	1= រសជាតិឆ្ងាញ់ 2= រសជាតិដូចទឹកត្រីដែលខ្ញុំតែងតែទិញ ☐ 3= រសជាតិដូចទឹកត្រីដែលខ្ញុំតែងតែធ្វើ 4= ផ្សេងៗ៖.....
22 c) ប្រសិនបើទេ ហេតុអ្វី?	1= ប្រៃពេក 2= រសជាតិខុសពីទឹកត្រីដែលខ្ញុំធ្លាប់ប្រើ ☐ 3= រសជាតិដូចថ្នាំ 4= ផ្សេងៗ-បញ្ជាក់.....
22 d) តើពណ៌របស់ទឹកត្រីអាចទទួលយកបានដែរឬទេ?	1= ចាស→ **សំណួរទី 22 f)** ☐ 2= ទេ
22 e) ប្រសិនបើទេ ហេតុអ្វី?	1= ពណ៌ចាស់/ក្រមៅពេក ☐ 2= ពណ៌ស្រាល/ថ្លាពេក 3= ផ្សេងៗ-បញ្ជាក់.....
22 f) ពេលខាងមុខ ប្រសិនបើទឹកត្រីដែលអ្នកបានទទួលក្នុងអំឡុងពេលសិក្សា មានលក់នៅក្នុងភូមិរបស់អ្នក តើអ្នកនឹងទិញវាដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 22. i)** ☐
22 g) ប្រសិនបើចាស ហេតុអ្វី?	1=រសជាតិឆ្ងាញ់ ☐ 2= ខ្ញុំគិតថាវាធ្វើអោយប្រសើរឡើងដល់សុខភាពគ្រួសាររបស់ខ្ញុំ 3= ផ្សេងៗ-បញ្ជាក់.....
22 h) តើអ្នកនឹងអាចទិញតម្លៃប៉ុន្មាន ចំពោះទឹកត្រីដូចបានចែកអោយ ដែលមួយដបមានចំណុះ៧៥០មីលីលីត្រដែរឬទេ?	☐☐☐☐ **រៀល** **ចប់សំណួរនេះ សូមរំលងទៅសំណួរ២៣**
22 i) ប្រសិនបើទេ ហេតុអ្វី?	1= ប្រៃពេក 2= រសជាតិខុសពីទឹកត្រីដែលខ្ញុំធ្លាប់ប្រើ ☐ 3= រសជាតិដូចថ្នាំ 4= ផ្សេងៗ-បញ្ជាក់.....

23. ឥឡូវខ្ញុំសូមសួរអ្នកអំពីរបៀបដែលគ្រួសារអ្នកបរិភោគទឹកត្រី	
23. a) នៅក្នុងគ្រួសាររបស់អ្នក តើអ្នកណាដែលបរិភោគទឹកត្រីច្រើនជាងគេបំផុត?	1. ម្តាយកុមារ 2. ឪពុកកុមារ ☐ 3. យាយកុមារ 4. តាកុមារ 5. ផ្សេងៗ-បញ្ជាក់:_____
23. b) ហេតុអ្វីបានជាគាត់ បរិភោគទឹកត្រីច្រើនជាងគេ?	1. គាត់ឃ្លានជាងគេបំផុត 2. គាត់ចូលចិត្តទឹកត្រីជាងគេបំផុត ☐ 3. គាត់ហូបច្រើនជាងគេ នៅពេលអាហារម្តងៗ 4. ផ្សេងៗ.....
23. c) នៅពេលដែលទឹកត្រីបានដាក់ក្នុងម្ហូប តើសមាជិកគ្រួសារទាំងអស់ហូបបរិមាណដូចគ្នាដែរឬទេ?	1= ចាស→ **សំណួរទី 24** ☐ 2= ទេ 3= ទឹកត្រីមិនប្រើក្នុងការចម្អិន→ **សំណួរទី 24**
23. d) ប្រសិនបើមិនដូច ហេតុអ្វី?	1. អ្នកធ្វើការច្រើនហូបច្រើន 2. ប្តីហូបច្រើន ☐ 3. អ្នកដែលចូលចិត្ត (សម្ល/ឆា/ខ...)ហូបច្រើនជាងគេ 4. ផ្សេងៗ.....
24. នៅពេលអ្នកទិញទឹកត្រីនៅផ្សារ តើជាធម្មតាអ្នកចំណាយប៉ុន្មានសម្រាប់ទឹកត្រីដែលមានចំណុះ750មីលីលីត្រ?	☐☐☐☐ **រៀល** ៨៨= ប្រសិនបើមិនដែលទិញទឹកត្រី
25.ឥឡូវខ្ញុំសូមសួរពីការគិតរបស់អ្នកស្តីពីផលិតផលបញ្ចូលជីវជាតិ។ ផលិតផលបញ្ចូលជីវជាតិគឺជាអាហារដែលបានបន្ថែមជីវជាតិ និងរ៉ែ ដើម្បីធ្វើអោយប្រសើរឡើងដល់សុខភាព និងការពារជម្ងឺ។ ឧទាហរណ៍អាហារដែលមានបញ្ចូលជីវជាតិ គឺអំបិលបញ្ចូលជាតិអ៊ីយ៉ូត ដែលសម្រាប់ការពារជំងឺពកក។	
25. a)តើអ្នកធ្លាប់ឮអំពីទឹកត្រីមានបញ្ចូលជាតិដែកដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 25f)** ☐
25. b) ប្រសិនបើធ្លាប់ តើឮពីកន្លែងណា?	1. ផ្សារ ឬអ្នកលក់ 2. អ្នកធ្វើការងារសុខភាព(អ្នកស្មគ្រ័ចិត្តសុខភាពភូមិ ឆ្មប វេជ្ជបណ្ឌិត គិលានុបដ្ឋានយិកា។ល។) ☐ 3. ឮពីអ្នកដែលអាចជឿជាក់បាន ដូចជា ប្រធានភូមិ 4. ពីមិត្តភក្តិ ឬសមាជិកគ្រួសារ 5.ផ្សេងៗ.....
25 c) តើអ្នកធ្លាប់ទិញទឹកត្រីបញ្ចូលជាតិដែកដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 25e)** ☐

25. d) ប្រសិនបើធ្លាប់ ហេតុអ្វី? **ពន្យល់ រួចទៅកាន់សំណួរ 25 f)**	1. វានឹងធ្វើអោយប្រសើរឡើងដល់សុខភាព 2. មានតែទឹកត្រីនេះ ☐ 3. អ្នកដែលអាចជឿជាក់បាន (គ្រូសារ មេភូមិ បុគ្គលិកសុខភាព)បានណែនាំអោយប្រើ 4. អ្នកចូលចិត្តរសជាតិវា 5. ផ្សេងៗ.....
25. e) ប្រសិនបើមិនទិញ ហេតុអ្វី?	1=ថ្លៃ 2= គ្មានលក់ ☐ 3= អ្នកមិនចូលចិត្តរសជាតិ 4= អ្នកមិនចូលចិត្តពណ៌ 5= ផ្សេងៗ.....
25. f) ប្រសិនបើទឹកត្រីមានបញ្ចូលទាំងជាតិដែក និងជីវជាតិដែលអាចធ្វើអោយប្រសើរឡើងដល់សុខភាពអ្នក (ជីវជាតិ B1) មានលក់ តើអ្នកនឹងទិញវាដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 25 h)** ☐
25 g) ប្រសិនបើចាស ហេតុអ្វី? **ពន្យល់ រួចរំលងទៅសំណួរ25 i)**	1. វានឹងធ្វើអោយប្រសើរឡើងដល់សុខភាព 2. អ្នកដែលអាចជឿជាក់បាន (គ្រូសារ មេភូមិ បុគ្គលិកសុខភាព)និងអាចណែនាំអោយប្រើ 3. គិតថាវាមានសុវត្ថិភាព និងគុណភាពខ្ពស់ជាងពីព្រោះវាមានការត្រួតពិនិត្យបានត្រឹមត្រូវ 4. អ្នកដទៃអាចទិញវា ☐ 5. ផ្សេងៗ.....
25. h)) ប្រសិនបើមិនទិញ ហេតុអ្វី? **ពន្យល់ រំលងទៅសំណួរ26**	1= វាទំនងជានឹងថ្លៃ 2= គាត់ចូលចិត្តធ្វើទឹកត្រីដោយខ្លួនឯង ☐ 3= គាត់ត្រូវតែធ្វើទឹកត្រីដោយខ្លួនឯង ពីព្រោះគាត់គ្មានលុយទិញទឹកត្រី 4= ផ្សេងៗ៖.....
25. i) តើអ្នកនឹងចំណាយលុយលើសប៉ុន្មានដើម្បីទិញផលិតផលនេះ (បើប្រៀបធៀបទៅនឹងទឹកត្រីដែលអ្នកតែងតែទិញ)?	_____រៀល

ផ្នែកទី4៖ ចំណេះដឹងស្តីពីកង្វះជីវជាតិB1 ជម្ងឺបេរីបេរី និងការចិញ្ចឹមទារកនិងកុមារតូច		
26. តើអ្នកធ្លាប់ឮអំពីជីវជាតិB1 ឬហ្សាមីន ដែរឬទេ?	1= ចាស 2= ទេ ☐	
27. តើអ្នកធ្លាប់ឮអំពីបញ្ហាកង្វះជីវជាតិB1 ឬជម្ងឺបេរីបេរី ដែរឬទេ?	1= ចាស 2= ទេ → សំណួរទី 33 ☐	
28. តើអ្នកដឹងអំពី អាការៈរោគនៃបញ្ហាកង្វះជីវជាតិB1ឬជម្ងឺបេរីបេរី ចំពោះទារកអាយុតិចជាង៦ខែដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 33** ☐	
29. តើអាការៈរោគនៃបញ្ហាកង្វះជីវជាតិB1 ឬជម្ងឺបេរីបេរី ចំពោះទារកអាយុតិចជាង៦ខែមានអ្វីខ្លះ?	a. ដង្ហើមញាប់ ☐ b. ចង្វាក់បេះដូងញាប់ ☐ c. ហើមដៃជើង ☐ d. ក្អួត ☐ e. នោមតិច ☐	f. ប្រកាច់ ☐ g. យំគ្មានសម្លេង ☐ h. មិនឃ្លាន ☐ i. ផ្សេងៗ.....

30.	តើអ្នកការពារ/ព្យាបាលបញ្ហាកង្វះជីវជាតិB1ឬជម្ងឺបេរីបេរី ចំពោះទារកអាយុតិចជាង៦ខែ ដោយរបៀបណា?	a. ម្តាយគួរតែបរិភោគអាហារសំបូរជីវជាតិB1 ☐ b. ម្តាយគួរតែបរិភោគអាហារដែលមានបញ្ចូលជីវជាតិB1ដូចជាទឹកត្រី ☐ c. ម្តាយគួរតែលេបបន្ថែមគ្រាប់ថ្នាំជីវជាតិB1 ☐ d. ទារកគួរតែបរិភោគអាហារសំបូរជីវជាតិB1 ☐ e. ទារកគួរតែបរិភោគអាហារដែលមានបញ្ចូលជីវជាតិB1ដូចជាទឹកត្រី ☐ f. ទារកគួរតែលេបបន្ថែមគ្រាប់ថ្នាំជីវជាតិB1 ☐ g. ផ្សេងៗ.....
31.	តើអ្នកអាចប្រាប់ឈ្មោះអាហារដែលសំបូរ ជីវជាតិB1 បានដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 33** ☐
32.	ប្រសិនបើចាស សូមប្រាប់ពីឈ្មោះអាហារដែលមានជីវជាតិB1ខ្ពស់? (សូមគូសចម្លើយទាំងអស់)	a. អង្ករសម្រូប ☐ b. ពពូកសណ្តែក ដូចជាសណ្តែកបាយ និងសណ្តែកបារាំង ☐ c. សាច់ជ្រូក ☐ d. គ្រឿងក្នុងសត្វ ☐ e. សណ្តែកសៀង តៅហ៊ូ និងផលិតផលធ្វើពីសណ្តែកសៀង ☐ f. ផ្សេងៗ.....
33.	តើទារកគួរបៅតែ**<u>ទឹកដោះម្តាយមួយតែមុខគត់</u>**រហូតដល់អាយុប៉ុន្មាន (បំបៅតែទឹកដោះម្តាយតែមួយមុខគត់ គ្មានទឹក ទឹកដូង ទឹកដោះគោ ឬអាហារផ្សេងៗទៀត)?	**ខែ** ☐☐ **88= មិនដឹង**
34.	តើកុមារគួរតែទទួលអាហារបន្ថែមក្រៅពីទឹកដោះម្តាយ នៅអាយុប៉ុន្មាន? (អាហារដែលផ្តល់ឱ្យកុមារ បន្ថែមទៅលើទឹកដោះ)	ខែ ☐☐ 88=មិនដឹង
35.	តើកុមារគួរតែបន្តបំបៅដោយទឹកដោះម្តាយ ជាមួយនឹងការផ្តល់អាហារផ្សេងៗទៀតដល់អាយុប៉ុន្មាន?	ខែ ☐☐ 88=មិនដឹង
36.	តើអ្វីខ្លះជាអាហារដំបូង ដែលកុមារគួរតែបរិភោគ ក្រៅពីទឹកដោះម្តាយ?	a. បបរកំប៉ុង ☐ b. បបរស ☐ c. បបរគ្រាប់គ្រឿង ☐ d. បាយអង្ករសម្រិត ☐ e. បាយចំហុយជាមួយអំបិល/សាច់/ទឹកត្រី/សម្ល/ផ្សេងៗ ☐ f. បាយពាតជាមួយអំបិល/សាច់/ទឹកត្រី/សម្ល/ផ្សេងៗ ☐ g. បន្លែ ឬផ្លែឈើពណ៌លឿង ☐ h. ស៊ុត ☐ e. ផ្សេងៗ.....
37.	តើកុមារគួរតែចាប់ផ្តើមបរិភោគអាហារគ្រួសារនៅអាយុប៉ុន្មាន?	ខែ ☐☐ 88=មិនដឹង

Appendix F

Thiamin fortified fish sauce as a means of combating infantile beriberi in rural Cambodia
Baseline Questionnaire – PREGNANT COHORT

BASELINE QUESTIONNAIRE
PREGNANT COHORT
Thiamin fortified fish sauce as a means of combating infantile beriberi in rural Cambodia

CONFIDENTIAL
All information collected in this survey is strictly confidential and will be used for statistical purposes only.

IDENTIFICATION INFORMATION	
Geographic Identification	**Interviewer Record**
Province: _____PREY VENG_____ District: _____ Commune: _____ Village: _____ Subject ID: __ __ __ __ __	Interviewer: ___ ___ Name: _____ Signature: _____ Remarks:
Date of Interview: (DD/MM/YYYY) ___ ___/ ___ ___/ ___ ___ ___ ___	

INFORMED CONSENT	
This participant, Subject ID __ __ __ __ __, has read/been read and understands the consent form, and has given voluntary, informed verbal consent to participate in this study.	1. Yes 2. No → Do **not** proceed ____

MODULE 1: CONFIRMING INCLUSION CRITERIA	
i) Are you the female head of your household?	1. Yes 2. No → Do **not** proceed ____
ii) Are you between the ages of 18 – 45 years?	1. Yes 2. No → Do **not** proceed ____
iii) Are you approximately 3 – 8 months pregnant with a singleton fetus?	1. Yes 2. No → Do **not** proceed ____
iv) Do you know your approximate due date?	1. Yes 2. No → Do **not** proceed ____
v) Do you have prior history of preeclampsia, pre-term delivery, or birth defects?	1. Yes → Do **not** proceed 2. No ____
vi) Do you plan to exclusively breastfeed your infant for 6 months?	1. Yes 2. No → Do **not** proceed ____
vii) Do you plan to move within the next six months?	1. Yes → Do **not** proceed 2. No ____
viii) Are you currently participating in any other study/intervention? (For example, homestead food production).	1. Yes → Do **not** proceed 2. No ____
ix) Will you agree to exclusively feed your entire family **only** the fish sauce provided by the study team for the next six months?	1. Yes 2. No → Do **not** proceed ____
x) Are you willing to provide a venous blood sample tomorrow and six months from now, and will you provide a breast milk sample and allow us to collect about 3 mL of blood from your infant's heel in six months?	1. Yes 2. No → Do **not** proceed ____
xi) Are you taking any dietary supplements containing vitamin B_1 (thiamin)?	1. Yes → Do **not** proceed 2. No ____

MODULE 2: PARTICIPANT INFORMATION	
1. How old are you?	_____ years
2. Approximately how many weeks pregnant are you?	_____ weeks
3. What is your approximate due date?	__ __ / __ __ / __ __ __ __ (DD/MM/YYYY)
4. How many antenatal visits have you attended?	_____ visits **If 0 → code, then proceed to Q8**
5. How many months pregnant were you at your first antenatal check-up?	_____ months 77 = unknown
6. Where did you attend these antenatal visits?	1. local health centre 2. district hospital 3. local birth attendant in your village ____ 4. private clinic or hospital 5. other - specify: _____
7. Who was the healthcare provider that conducted your antenatal check-ups?	1. government health centre staff 2. private clinic/hospital staff 3. traditional birth attendant 4. village health volunteer ____ 5. other - specify: _____
8. Where do you plan to give birth to your child?	1. local health centre 2. district hospital 3. local birth attendant in your village 4. in your home, without a birth attendant 5. undecided 6. private clinic or hospital ____ 7. other: _____
9. Have you taken any deworming tablets since becoming pregnant?	1. Yes 2. No ____
10. Did you purchase or were you given any iron folic acid tablets since becoming pregnant?	1. Yes 2. **No → code, then proceed to Q12** ____
11. How many iron folic acid tablets have you taken since you became pregnant?	_____ tablets
12. How many people currently live in your household (defined as eating from the same pot each day)?	_____ people
13. How many children have you given birth to?	_____ children, or **If 0 → code, then proceed to Q21**
14. I would like to ask about the children you have given birth to who are currently living in your household. How many children are within the following age ranges?	a) 0 - 6 months ____ b) 7 - 23 months ____ c) 2 - 5 years ____ d) >5 years ____
15. How old is your youngest child?	____ / ____ / _____ (DD/MM/YYYY) (_____ months)

16. Did you breastfeed, or are you currently breastfeeding, your youngest child?	1. Yes 2. **No → code, then proceed to Q21** ____
17. Until what age did you **exclusively** breastfeed your child (fed **only** breast milk, not water, coconut milk, or any other foods)?	_____ months 77 = still currently **exclusively** breastfeeding
18. Until what age did you continue to breastfeed your youngest child while also providing other foods?	_____ months 77 = still currently **exclusively** breastfeeding 99 = still currently breastfeeding
19. How long has it been since you **stopped** breastfeeding your youngest child?	_____ months 77 = still currently **exclusively** breastfeeding 99 = still currently breastfeeding
20. At what age did your youngest child start receiving complimentary foods (foods provided in addition to breast milk)?	_____ months 77 = still currently **exclusively** breastfeeding
21. Have you completed any schooling?	1. Yes 2. **No → code, then proceed to Q23** ____
22. What is the highest level of school you attended?	1. Primary school 2. Lower Secondary school 3. Upper Secondary school 4. Higher education ____
23. Has your husband/partner completed any schooling?	1. Yes 2. **No → code, then proceed to Q25** ____
24. What is the highest level of schooling your husband/partner attended?	1. Primary school 2. Lower Secondary school 3. Upper Secondary school 4. Higher education ____
25. What was the income for your household last **month**?	US$_____
26. What was the income for your household in the past **12 months**?	US$_____

MODULE 3: FOOD INTAKE

27. I would like to ask you about the foods and drinks that you may have consumed **yesterday** during the day or night. I want to know how often you ate the food, approximately how much of the food you ate in a typical serving, and how it was consumed.

Food Type	Consumed yesterday	If yes, how often?	Amount per typical serving (g or mL)	Consumed alone, or with other foods?
a) White Rice, and white rice borbor	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____

b) Bread, brown rice, noodles, porridge, or other foods made from grains? (**Other than white rice**.)	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
c) Pumpkin, carrots, squash, or sweet potatoes that are yellow or orange inside?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
d) White potatoes, white yams, manioc, cassava, or any other foods made from roots?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
e) Dark leafy green vegetables (eg. kang kong)	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
f) Ripe mangoes, papayas or any other yellow or orange fruits?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
g) Other fruits or vegetables?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
h) Liver, kidney, heart, or other organ meats?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
i) Meat, such as beef, pork, lamb, goat, chicken, or duck?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
j) Eggs?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
k) Fresh or dried fish and shellfish (including snails, crab, squid)?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____

l) Foods made from beans, peas, lentils, or nuts?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
m) Cheese or other foods made from milk?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
n) Foods made with oil, fat, or butter?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
o) Snake, frog, rats, or insects?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
p) Sugary foods such as pastry, cakes, chocolates, sweets, or candies?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____

28. How many meals and snacks did you consume yesterday?	a) _____ meals, **and** b) _____ snacks
29. Was yesterday's food intake typical/usual for you?	**1. Yes→ code, then proceed to Q31** 2. No ____
30. If no, why was it not typical/usual?	1. I was ill 2. I was not hungry 3. There was not enough food ____ 4. It was a celebration (ate more or differently) 5. Other – specify:_____ ____
31. Who is primarily responsible for food preparation in your household?	1. Self (woman) 2. Husband/partner 3. Grandmother 4. Grandfather 5. Male children ____ 6. Female children 7. Other – specify:_____
32. Since becoming pregnant, do you tend to eat more, less, or the same amount of food as before?	1. more food 2. less food 3. same amount of food as before 4. other: _____ ____

MODULE 4: FISH SAUCE CONSUMPTION

33. Now I would like to ask you about your fish sauce consumption. During the **past week**, did you consume fish sauce …

Food Type	Consumed in last week	If yes, how often?	Amount per typical serving (mL)	Describe consumption/ food preparation
a) Fish sauce as a condiment	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____		1. fish sauce **alone** in small bowl 2. fish sauce with chilies/garlic/MSG/lime/lemon in small bowl 3. other – specify: _____ _____
b) Fish sauce, in the common pot	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____		1. in soup 2. In stir fry 3. In khor 4. other – specify: _____ _____
c) Other – specify: _____	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____		

34. During the **past day** (yesterday, during the day and at night), did you consume fish sauce …

Food Type	Consumed yesterday	If yes, how often?	Amount per typical serving (mL)	Describe consumption, food preparation
a) Fish sauce as a condiment	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. fish sauce **alone** in small bowl 2. fish sauce with chilies/garlic/MSG/lime/lemon in small bowl 3. other – specify: _____ _____
b) Fish sauce, in the common pot	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. in soup 2. In stir fry 3. In khor 4. other – specify: _____ _____
c) Other – specify: _____	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		

35. The following questions will relate to buying fish sauce.	
35. a) Do you purchase fish sauce at market?	1. Yes 2. **No → code, then proceed to Q36** _____
35. b) Which brand of fish sauce do you typically purchase?	Brand: _____ → if unable to answer, code: 1. Has brand, but unknown 2. No brand – purchased in bulk 3. No brand – homemade by seller _____
35. c) Do you always purchase the same brand of fish sauce?	1. Yes 2. **No → code, then proceed to Q35e)** _____
35. d) If yes, why?	1. delicious 2. inexpensive 3. habit 4. Only fish sauce available 5. Other – specify : _____ _____
35. e) How much fish sauce do you purchase at once (volume of container)?	_____ mL
35. f) How long does this amount of fish sauce last in your household?	_____ days
35. g) How much does this fish sauce usually cost?	_____ Riel
35. h) Under what conditions is fish sauce stored in your home?	1. on a shelf at room temperature (in the shade) 2. on a shelf at room temperature (in the sun) 3. in a refrigerator, or in a cool box with ice 4. other - specify: _____
35. i) How is fish sauce typically served/prepared for consumption in your household?	1. in soup 2. in stir fry 3. as a condiment (poured on food, or for dipping) 4. In soup AND as a condiment 5. In stir-fry AND as a condiment 6.. other - specify: _____ _____
36. I would now like to ask about how your family eats fish sauce.	
36. a) In your household, who consumes the most fish sauce?	1. you (woman) 2. your husband/partner 3. grandmother 4. grandfather 5. other - specify: _____ _____
36. b) Why does this person consume the most fish sauce?	1. they have the largest appetite 2. they prefer fish sauce the most 3. they are fed the largest portion of each meal 4. other - specify: _____ _____

36. c) When fish sauce is consumed from the common pot, do all adult members of your household consume the same amount?	1. **Yes → code, then proceed to Q37** 2. No 3. fish sauce not used in common pot _____
36. d) If no, why?	1. person who works the most eats more 2. husband eats more 3. person who prefers the food from the common pot the most eats more 4. other - specify: _____ _____
37. I would now like to ask your opinion about fortified products. A fortified product is a food that has added vitamins or minerals to improve health and prevent disease. One example of a fortified food is iodized salt, which is fortified to prevent goiters.	
37. a) Do you regularly purchase iodized salt?	1. Yes 2. **No → code, and proceed to Q37c)** _____
37.b) If yes, why? **Explain, then proceed to Q35.d)**	1. because you know it will improve health 2. because it is the only salt available 3. because a trusted person (family member, village chief, health professional) recommended it 4. because you prefer the taste 5. other - specify: _____ _____
37. c) If no, why?	1. because it is more expensive 2. because iodized salt is not available 3. because you do not like the taste 4. because iodized salt is not available to purchase 4. other - specify: _____ _____
37. d) Have you heard of iron-fortified fish sauce?	1. Yes 2. **No → code, then proceed to Q37h)** _____
37. e) If yes, from where did you hear about iron-fortified fish sauce?	1. media (TV, radio, newspapers) 2. posters in the village 3. heard from a trusted person (family member, village chief, health professional) 4. Other - specify: _____ _____
37. f) Have you purchased iron fortified fish sauce?	1. Yes 2. **No → code, then proceed to Q37h)** _____
37. g) If yes, why?	1. because you know it will improve health 2. because it is the only fish sauce available 3. because a trusted person (family member, village chief, health professional) recommended it 4. because you prefer the taste 5. other – specify: _____ _____
37. h) If a fish sauce became available that contained both iron and a vitamin that would improve your health (vitamin B_1), would you	1. Yes 2. **No → code, then proceed to 37j)**

purchase this product?	_____
37. i) If yes, why? **Explain, then proceed to Q37k)**	1. improves health 2. recommended by a trusted person (family member, village chief, health professional) 3. product deemed safer or quality more carefully regulated 4. other people are purchasing it 5. Other - specify: _____ _____
37. j) If no, why? **Explain, then proceed to Q38**	
37. k) How much **more** money would you be willing to pay for this product (as compared to what you usually spend on fish sauce)?	_____ Riel, OR 1. family does not purchase fish sauce ____

MODULE 5: KNOWLEDGE OF THIAMIN DEFICIENCY, BERIBERI, AND INFANT AND YOUNG CHILD FEEDING (IYCF)	
38. Have you ever heard of vitamin B_1, also known as thiamin?	1. Yes 2. No _____
39. Have you ever heard of vitamin B_1 (thiamin) deficiency, or beriberi?	1. Yes 2. **No → code, then proceed to Q43** _____
40. Do you know any symptoms of vitamin B_1 (thiamin) deficiency or beriberi in infants less than 6 months old?	1. Yes 2. **No → code, then proceed to Q43** _____
41. What are the symptoms of vitamin B_1 (thiamin) deficiency or beriberi in infants less than 6 months old?	
42. How do you treat vitamin B_1 (thiamin) deficiency or beriberi in infants less than 6 months old?	
43. Until what age should infants be **exclusively** breastfed (fed **only** breast milk, not water, coconut water, or any foods)?	_____ months 88 = unknown
44. At what age should children start receiving complimentary foods (foods that are provided to children in addition to breast milk)?	_____ months 88 = unknown
45. Until what age should children **continue** to be breastfed while also eating other foods?	_____ months 88 = unknown
46. What are the first foods a child should eat, other than breast milk?	1. _____ 2. _____ 3. _____
47. When should a child start eating foods from the family pot?	_____ months 88 = unknown

MODULE 6: ANTHROPOMETRIC MEASUREMENTS	
48. Height of **Participant**	1) __ __ __ . __ cm 2) __ __ __ . __ cm 3) __ __ __ . __ cm
49. Weight of **Participant**	1) __ __ . __ __ kg 2) __ __ . __ __ kg 3) __ __ . __ __ kg

Thank you so much for your time!

a place of mind

UBC

Helen Keller INTERNATIONAL

បញ្ជីសំណួរការអង្កេតមូលដ្ឋានគ្រឹះ-ក្រុមស្ត្រីមានផ្ទៃពោះ

ទឹកត្រីបញ្ចូលជីវជាតិB1 ជាមធ្យោបាយក្នុងការទប់ស្កាត់ជម្ងឺបេរីបេរីចំពោះទារក នៅតាមជនបទប្រទេសកម្ពុជា

ការសំងាត់

រាល់ព័ត៌មានដែលប្រមូលបាននៅក្នុងការសិក្សាស្រាវជ្រាវនេះនឹងត្រូវបានរក្សាជាការសំងាត់ និងប្រើប្រាស់ក្នុង គោលបំណងបែបស្ថិតិប៉ុណ្ណោះ ។

ព័ត៌មានកំណត់សំគាល់	
កំណត់សំគាល់ភូមិសាស្ត្រ	**កំណត់សំគាល់អ្នកសម្ភាសន៍**
ខេត្ត: ..... ស្រុក: ..... ឃុំ: ..... ភូមិ: ..... លេខសំគាល់សំណាក: ☐☐☐☐☐	អ្នកសម្ភាសន៍ ☐☐ ឈ្មោះ ..... ហត្ថលេខា: ..... កំណត់សម្គាល់ .....
កាលបរិច្ឆេទការសម្ភាសន៍: (ថ្ងៃ /ខែ /ឆ្នាំ) __/__/____	

ការអនុញ្ញាតផ្ទាល់មាត់	
អ្នកផ្តល់ចម្លើយ (លេខសំគាល់សំណាក ☐☐☐☐☐) បានអាន ឬបានស្តាប់ យល់ពីលិខិតសុំការអនុញ្ញាតស្មគ្រចិត្ត និងយល់ព្រមដោយផ្ទាល់មាត់ ដើម្បីចូលរួមក្នុងការសិក្សាស្រាវជ្រាវនេះ	1= ចាស ☐ 2= ទេ → **បញ្ចប់ការសម្ភាសន៍**

ផ្នែកទី1. ការពិនិត្យមើលលក្ខខណ្ឌអ្នកដែលអាចចូលរួមក្នុងការសម្ភាសន៍	
i)តើអ្នកជាស្ត្រីមេគ្រួសារមែនដែរឬទេ?	1= ចាស 2= ទេ → **មិនត្រូវសម្ភាសន៍ទេ** ☐
ii) តើអ្នកមានអាយុចន្លោះពី១៨ទៅ៤៥ឆ្នាំមែនដែរឬទេ?	1= ចាស 2= ទេ → **មិនត្រូវសម្ភាសន៍ទេ** ☐
iii) តើអ្នកមានផ្ទៃពោះប្រហែលជា៣ទៅ៨ខែ ហើយមានគិកតែមួយមែនទេ?	1= ចាស 2= ទេ → **មិនត្រូវសម្ភាសន៍ទេ** ☐
iv) តើអ្នកដឹងថា អ្នកគ្រប់ខែដល់ថ្ងៃសម្រាលនៅពេលណាដែរឬទេ?	1= ចាស 2= ទេ → **មិនត្រូវសម្ភាសន៍ទេ** ☐
V) តើអ្នកធ្លាប់មានប្រវត្តិឡើងឈាម សម្រាលមុនខែ កូនកើតមកមានរាងកាយមិនប្រក្រតីដែរឬទេ?	1= ចាស→ **មិនត្រូវសម្ភាសន៍ទេ** 2= ទេ ☐
Vi) តើអ្នកមានគម្រោងបំបៅទឹកដោះម្តាយតែមួយមុខគត់ដល់កូនរបស់អ្នកបានយ៉ាងហោចណាស់៦ខែដែរឬទេ?	1= ចាស 2= ទេ → **មិនត្រូវសម្ភាសន៍ទេ** ☐
Vii) តើអ្នកមានគម្រោងចង់ចាញ់ចេញនៅក្នុងអំឡុងពេល៦ខែនេះដែរឬទេ?	1= ចាស→ **មិនត្រូវសម្ភាសន៍ទេ** 2= ទេ ☐
viii) បច្ចុប្បន្ន តើអ្នកកំពុងចូលរួមជាមួយការសិក្សា/កិច្ចអន្តរាគមន៍ណាមួយដែរឬទេ? (ឧ. កម្មវិធីផលិតកម្មស្បៀងតាមគ្រួសារ)	1= ចាស→ **មិនត្រូវសម្ភាសន៍ទេ** 2= ទេ ☐
ix) ក្នុងអំឡុងពេល៦ខែបន្ទាប់ តើអ្នកយល់ព្រមក្នុងការប្រើ**<u>តែទឹកត្រី</u>**ដែលផ្តល់ដោយក្រុមការងាររបស់យើង សម្រាប់ការបរិភោគក្នុងគ្រួសារទាំងមូលដែរឬទេ?	1= ចាស 2= ទេ → **មិនត្រូវសម្ភាសន៍ទេ** ☐
x) តើអ្នកយល់ព្រមចូលរួមក្នុងការបូមឈាម នៅថ្ងៃស្អែក និងម្តងទៀតនៅរយៈពេល៦ខែក្រោយ និងអោយសំណាកទឹកដោះ ព្រមទាំងអនុញ្ញាតិអោយយើងជោះឈាមពីកែងជើងទារករបស់អ្នក ប្រហែលជា**៣មីលីលីត្រ** នៅរយៈពេល៦ខែក្រោយដែរឬទេ?	1= ចាស 2= ទេ → **មិនត្រូវសម្ភាសន៍ទេ** ☐
xi) តើអ្នកមានកំពុងលេបថ្នាំបន្ថែម មានជីវជាតិB1ដែរឬទេ?	1= ចាស→ **មិនត្រូវសម្ភាសន៍ទេ** 2= ទេ ☐

ផ្នែកទី 2 ៖ ព័ត៌មានអ្នកចូលរួម	
1. តើអ្នកមានអាយុប៉ុន្មាន?	☐☐ឆ្នាំ
2. តើអ្នកមានផ្ទៃពោះប្រហែលជាប៉ុន្មានអាទិត្យហើយ?	☐☐អាទិត្យ
3. តើអ្នកនឹងសម្រាលនៅពេលណា?	ថ្ងៃ ☐☐ ខែ ☐☐ ឆ្នាំ☐☐☐☐
4. តើអ្នកបានទៅពិនិត្យផ្ទៃពោះប៉ុន្មានដងហើយ?	☐☐ ដង **ប្រសិនបើ 0 → សូមរំលងទៅសំណួរទី8**
5. តើអ្នកទៅពិនិត្យផ្ទៃពោះលើកដំបូង នៅពេលអ្នកមានផ្ទៃពោះប៉ុន្មានខែ?	☐☐ ខែ 77=មិនដឹង

6. តើអ្នកទៅពិនិត្យផ្ទៃពោះនៅកន្លែងណា?	1. មណ្ឌលសុខភាព 2. មន្ទីរពេទ្យស្រុក ☐ 3. ឆ្មបក្នុងភូមិ 4. មន្ទីរពេទ្យ/គ្លិនិកឯកជន 5. ផ្សេងៗ.....
7. តើអ្នកផ្តល់សេវាថែទាំសុខភាពមួយណា ជាអ្នកពិនិត្យផ្ទៃពោះអោយអ្នក?	1. បុគ្គលិកពេទ្យរដ្ឋ 2. បុគ្គលិកពេទ្យឯកជន ☐ 3. ឆ្មបបុរាណ 4. អ្នកស្ម័គ្រចិត្តសុខភាពភូមិ 5. ផ្សេងៗ.....
8. តើអ្នកនឹងទៅសម្រាលកូននៅកន្លែងណា?	1. មណ្ឌលសុខភាព 2. មន្ទីរពេទ្យស្រុក 3. ឆ្មបក្នុងភូមិ ☐ 4. នៅផ្ទះ ដោយគ្មានឆ្មប 5. មិនទាន់សម្រេចចិត្ត 6. មន្ទីរពេទ្យ/គ្លិនិកឯកជន 7. ផ្សេងៗ.....
9. តើអ្នកមានលេបថ្នាំគ្រាប់ទម្លាក់ព្រូនដែរឬទេ ចាប់តាំងពីអ្នកមានផ្ទៃពោះ?	1= ចាស ☐ 2= ទេ
10. តើអ្នកបានទិញឬទទួល គ្រាប់ថ្នាំជាតិដែក/ហ្វូលីតអាស៊ីតដែរឬទេ ក្នុងអំឡុងពេលមានផ្ទៃពោះនេះ?	1= ចាស ☐ 2= ទេ → **សូមរំលងទៅសំណួរ12**
11. តើអ្នកបានលេប គ្រាប់ថ្នាំជាតិដែក/ហ្វូលីតអាស៊ីតចំនួនប៉ុន្មានគ្រាប់ ក្នុងអំឡុងពេលមានផ្ទៃពោះនេះ?	☐☐ គ្រាប់
12. បច្ចុប្បន្ននេះ តើមានមនុស្សប៉ុន្មាននាក់រស់នៅក្នុងផ្ទះរបស់អ្នក? (រាប់អ្នកដែលហូបបាយជាមួយគ្នា រាល់ថ្ងៃ)	☐☐ នាក់
13. តើអ្នកបានផ្តល់កំណើតដល់កូន ប៉ុន្មាននាក់?	☐☐ នាក់ **បើសូន្យនាក់ → សំណួរទី 21**
14. ខ្ញុំសូមសួរអ្នកអំពីកូនបង្កើតរបស់អ្នក ដែលកំពុងរស់នៅក្នុងផ្ទះអ្នក។ តើមានប៉ុន្មាននាក់ដែលមានអាយុទាំងនោះ?	a) 0 - 6 ខែ ☐ b) 7 - 23 ខែ ☐ c) 2 - 5 ឆ្នាំ ☐ d) >5 ឆ្នាំ ☐
15. តើកូនពៅគេរបស់អ្នកអាយុប៉ុន្មាន?ថ្ងៃខែឆ្នាំកំណើត?	ថ្ងៃខែឆ្នាំកំណើត _____/_____/_____ អាយុជាខែ ☐☐
16. តើអ្នកមានបានឬកំពុងបំបៅដោះកូនពៅគេបង្អស់របស់អ្នកដែរឬទេ?	1= ចាស ☐ 2= ទេ → **រំលងទៅសំណួរទី21**
17. តើអ្នកបានបំបៅតែ**<u>ទឹកដោះម្តាយមួយមុខគត់</u>**ដល់កូនពៅគេបង្អស់របស់អ្នកដល់អាយុប៉ុន្មាន (បំបៅតែទឹកដោះម្តាយតែមួយមុខគត់ គ្មានទឹក ទឹកដូង ទឹកដោះគោ ឬអាហារផ្សេងៗទៀត)?	ខែ ☐☐ 77=បច្ចុប្បន្ននៅបំបៅដោះម្តាយតែ១មុខគត់

18. តើអ្នកបានបន្តបំបៅកូនដោយទឹកដោះម្តាយ ជាមួយនឹងការផ្តល់អាហារផ្សេងៗទៀតដល់កូនពៅគេបង្អស់របស់អ្នកដល់អាយុប៉ុន្មាន?	ខែ ☐☐ 77=បច្ចុប្បន្ននៅបំបៅដោះម្តាយតែ១មុខគត់ 99=បច្ចុប្បន្ននៅបំបៅដោះម្តាយ
19. រាប់មកដល់ឥឡូវ តើអ្នកផ្តាច់ដោះកូនពៅគេបង្អស់ របស់អ្នកយូរប៉ុណ្ណាហើយ?	1= ☐☐ ខែ 77=បច្ចុប្បន្ននៅបំបៅដោះម្តាយតែ១មុខគត់ 99=បច្ចុប្បន្ននៅបំបៅដោះម្តាយ
20. តើកូនពៅគេបង្អស់របស់អ្នក ចាប់ផ្តើមហូបអាហារបន្ថែម នៅអាយុប៉ុន្មាន (ក្រៅពីទឹកដោះម្តាយ)?	ខែ ☐☐ 77=បច្ចុប្បន្ននៅបំបៅដោះម្តាយតែ១មុខគត់
21. តើអ្នកធ្លាប់ចូលរៀនដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 23** ☐
22. តើអ្នកបានរៀនដល់កំរិតណា?	1= បឋមសិក្សា 2= អនុវិទ្យាល័យ 3= វិទ្យាល័យ 4= ឧត្តមសិក្សា ☐
23. តើប្តីរបស់អ្នកធ្លាប់ចូលរៀនដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 25** ☐
24. តើប្តីរបស់អ្នកបានរៀនដល់កំរិតណា?	1= បឋមសិក្សា 2= អនុវិទ្យាល័យ 3= វិទ្យាល័យ 4= ឧត្តមសិក្សា ☐
25. តើគ្រួសាររបស់អ្នករកចំណូលបានប៉ុន្មាន ក្នុងអំឡុងពេល**១ខែ**កន្លងមកនេះ?	ដុល្លាអាមេរិក ☐☐☐☐
26. តើគ្រួសាររបស់អ្នករកចំណូលបានប៉ុន្មាន ក្នុងអំឡុងពេល**១២ខែ**កន្លងមកនេះ?	ដុល្លាអាមេរិក ☐☐☐☐

ផ្នែកទី 3: ការបរិភោគអាហារ

27. ខ្ញុំសូមសួរអ្នកអំពីអាហារ និងភេសជ្ជៈ ដែលអ្នកបានបរិភោគ **កាលពីម្សិលមិញ** នៅពេលថ្ងៃ ឬពេលយប់។ ខ្ញុំចង់ដឹងពីចំនួនដង បរិមាណអាហារ និងរបៀបដែលអ្នកបានបរិភោគ។

ប្រភេទអាហារ	បានបរិភោគកាលពីម្សិលមិញ	បើបាន ញឹកញាប់ប៉ុណ្ណា?	បរិមាណក្នុងពេលបរិភោគម្តង (ក្រាម ឬមីលីលីត្រ)	បរិភោគតែមួយមុខ ឬលាយជាមួយអាហារផ្សេងទៀត?
a. បាយអង្ករសម្រិត/បបរអង្ករសម្រិត	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ ☐ 2= លាយជាមួយអាហារផ្សេងទៀត រៀបរាប់:.....
b នំប៉័ង/បាយអង្ករសំរូប/មី/បបរ ឬអាហារធ្វើពីគ្រាប់ធញ្ញជាតិផ្សេងទៀត? (ក្រៅពីអង្ករសម្រិត)	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត ☐ រៀបរាប់:.....
c. ល្ពៅ ការ៉ុត ឬដំឡូងជ្វាសាច់ពណ៌លឿង ឬពណ៌ទឹកក្រូច	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត ☐ រៀបរាប់:.....
d. ដំឡូងជ្វាសាច់ពណ៌ស ដំឡូងមី ត្រាវ សាគូ ឬអាហារផ្សេងៗធ្វើពីមើមរុក្ខជាតិ	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត ☐ រៀបរាប់:.....
e. បន្លែស្លឹកពណ៌បៃតងចាស់ (ឧ. ត្រកួន)	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត ☐ រៀបរាប់:.....
f. ស្វាយទុំ ល្ពៅទុំ ឬផ្លែឈើពណ៌លឿងទុំដទៃទៀត?	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត ☐ រៀបរាប់:.....
g. បន្លែ ឬផ្លែឈើដទៃទៀត?	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត ☐ រៀបរាប់:.....
h. ថ្លើម ក្រលៀន បេះដូង ឬគ្រឿងក្នុងដទៃទៀត?	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត ☐ រៀបរាប់:.....

i. សាច់សត្វ ដូចជាសាច់គោ សាច់ជ្រូក សាច់ចៀម សាច់ពពែ សាច់មាន់ សាច់ទា?	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារ ផ្សេងទៀត ☐ រៀបរាប់:.....
j. ស៊ុត?	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារ ផ្សេងទៀត ☐ រៀបរាប់:.....
k. ត្រីស្រស់ ឬត្រីងៀត ខ្យង ខ្ចៅ ក្តាម មឹក?	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារ ផ្សេងទៀត ☐ រៀបរាប់:.....
L. អាហារធ្វើពីសណ្តែក ឬសណ្តែកដី	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារ ផ្សេងទៀត ☐ រៀបរាប់:.....
m. ឈីស ឬអាហារធ្វើពីទឹកដោះគោ?	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារ ផ្សេងទៀត ☐ រៀបរាប់:.....
n. អាហារធ្វើពីប្រេង ខ្លាញ់ ឬប៊ឺរ?	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារ ផ្សេងទៀត ☐ រៀបរាប់:.....
o. ពស់ កង្កែប កណ្តុរ ឬសត្វល្អិត?	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារ ផ្សេងទៀត ☐ រៀបរាប់:.....
p. អាហារមានជាតិផ្អែម (ស្ករ) ដូចជាស្ករគ្រាប់ សុកក្លូឡា នំ បង្អែម?	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារ ផ្សេងទៀត ☐ រៀបរាប់:.....

28. កាលពីម្សិលមិញ តើអ្នកបានបរិភោគអាហារពេល ឬអាហារក្រៅពេលប៉ុន្មានដង?	a. អាហារពេល ☐☐ b. អាហារក្រៅពេល ☐☐
29. តើអ្នកតែងតែញ៉ាំធម្មតាដូចនេះ ដែរឬទេ?	1= ចាស→ **សំណួរទី 31** ☐ 2= ទេ
30. ប្រសិនបើមិនធម្មតា តើខុសគ្នាដូចម្តេច? **សូមគូសយកចម្លើយដែលបានឆ្លើយទាំងអស់** **កូដ 0=ទេ 1=ចាស**	1. ឈឺ ☐ 2. មិនឃ្លាន ☐ 3. គ្មានអាហារគ្រប់គ្រាន់ ☐ 4. មានពិធី (ហូបច្រើន ឬផ្សេង) ☐ 5. ផ្សេងៗ-បញ្ជាក់: _____

31. អ្នកណាជាអ្នកទទួសខុសត្រូវចម្បងក្នុងការរៀបចំអាហារក្នុងគ្រួសាររបស់អ្នក?	1. ខ្លួនឯង (ស្ត្រី) 2. ប្តី ☐ 3. យាយ 4.តា 5. កូនប្រុស 6. កូនស្រី 7. ផ្សេងៗ-បញ្ជាក់:_____
32. ចាប់តាំងពីពេលមានផ្ទៃពោះមក តើអ្នកហូបច្រើនជាង តិចជាង ឬដូចពេលមិនទាន់មានផ្ទៃពោះ?	1. ហូបច្រើនជាងមុន 2. ហូបតិចជាងមុន ☐ 3. ដូចមុន 4. ផ្សេងៗ.....

ផ្នែកទី 4 ៖ការបរិភោគទឹកត្រី

33. ឥឡូវ ខ្ញុំសូមសួរអ្នកអំពីការបរិភោគទឹកត្រីរបស់អ្នកៗ កាលពី**មួយអាទិត្យកន្លង**មកនេះ តើអ្នកបានបរិភោគទឹកត្រី.....ដែរឬទេ?

ប្រភេទអាហារ	**បានបរិភោគកាលពីមួយអាទិត្យកន្លងមក**	**បើបាន ញឹកញាប់ប៉ុណ្ណា?**	**បរិមាណក្នុងពេលបរិភោគម្តង (មីលីលីត្រ)**	**ពិពណ៌នាការបរិភោគ/ការរៀបចំអាហារ**
a. ហូបទឹកត្រីផ្ទាល់	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= 1-3ដងក្នុងមួយសប្តាហ៍ 2= 4-6ដងក្នុងមួយសប្តាហ៍ ☐ 3= 7-9ដងក្នុងមួយសប្តាហ៍ 4= ចាប់ពី១0ដងក្នុងមួយសប្តាហ៍		1= ទឹកត្រីតែមួយគត់ដាក់ក្នុងកូនចាន ☐ 2= ទឹកត្រីជាមួយម្ទេស/ខ្ទឹម/ប៊ីចេង/ក្រូចឆ្មារដាក់ក្នុងកូនចាន 3= ផ្សេងៗបញ្ជាក់ .....
b. ទឹកត្រីដាក់ក្នុងសម្ល	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= 1-3ដងក្នុងមួយសប្តាហ៍ 2= 4-6ដងក្នុងមួយសប្តាហ៍ ☐ 3= 7-9ដងក្នុងមួយសប្តាហ៍ 4= ចាប់ពី១0ដងក្នុងមួយសប្តាហ៍		1= ដាក់ក្នុងសម្ល ☐ 2= ដាក់ក្នុងឆា 3= ដាក់ក្នុងខ 3= ផ្សេងៗបញ្ជាក់ .....
c. ផ្សេងៗ-បញ្ជាក់: _____	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= 1-3ដងក្នុងមួយសប្តាហ៍ 2= 4-6ដងក្នុងមួយសប្តាហ៍ ☐ 3= 7-9ដងក្នុងមួយសប្តាហ៍ 4= ចាប់ពី១0ដងក្នុងមួយសប្តាហ៍		

34. កាលពី**ម្សិលមិញ** (ទាំងពេលយប់ និងពេលថ្ងៃ) តើអ្នកបានបរិភោគទឹកត្រី.....ដែរឬទេ?

ប្រភេទអាហារ	**បានបរិភោគកាលពីម្សិលមិញ**	**បើបាន ញឹកញាប់ប៉ុណ្ណា?**	**បរិមាណក្នុងពេលបរិភោគម្តង (មីលីលីត្រ)**	**ពិពណ៌នាការបរិភោគ/ការរៀបចំអាហារ**
a. ហូបទឹកត្រីផ្ទាល់	១. ចាស ☐ ២. ទេ → ជូរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= ទឹកត្រីតែមួយគត់ដាក់ក្នុងកូនចាន ☐ 2= ទឹកត្រីជាមួយម្ទេស/ខ្ទឹម/ប៊ីចេង/ក្រូចឆ្មារដាក់ក្នុងកូនចាន 3= ផ្សេងៗបញ្ជាក់ .....

b. ទឹកត្រីដាក់ក្នុងសម្លៃ	១. ចាស ☐ ២. ទេ → ជួរបន្ទាប់	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= ដាក់ក្នុងសម្ល ☐ 2= ដាក់ក្នុងឆា 3= ដាក់ក្នុងខ 3= ផ្សេងៗបញ្ជាក់ .....
c. ផ្សេងៗ-បញ្ជាក់: _____	១. ចាស ☐ ២. ទេ → ជួរបន្ទាប់	1= ម្តង 2= ពីរដង 3= បីដង 4= ច្រើនជាងបីដង		

35. ខាងក្រោមគឺជាសំណួរដែលទាក់ទងទៅនឹងការទិញទឹកត្រី

35.a) តើអ្នកទិញទឹកត្រីនៅផ្សារដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 36** ☐
35.b) តើអ្នកនិយមទិញទឹកត្រីម៉ាកអ្វី?	ម៉ាក:.....ប្រសិនបើមិនអាចឆ្លើយ សូមដាក់កូដ ១=មានម៉ាក-មិនចាំ ២=គ្មានម៉ាក-ទិញរាយ ☐ ៣=គ្មានម៉ាក-អ្នកលក់ធ្វើដោយខ្លួនឯង
35.c) តើអ្នកតែងតែទិញទឹកត្រីម៉ាកដដែលៗដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 35e** ☐
35.d) ប្រសិនបើចាស ហេតុអ្វី?	១=ឆ្ងាញ់ ២=តម្លៃថោក ៣=ទម្លាប់ ☐ ៤=មានតែទឹកត្រីនេះ ៥=ផ្សេងៗ.....
35.e) តើអ្នកទិញទឹកត្រីម្តងចំណុះប៉ុន្មាន? (ចំណុះនៅលើដប)	☐☐☐ មីលីលីត្រ
35.f) តើអ្នកអាចប្រើទឹកត្រីនេះបានរយៈពេល ប៉ុន្មានថ្ងៃ?	☐☐ ថ្ងៃ
35.g) តើជាទូទៅទឹកត្រីនេះមានតម្លៃប៉ុន្មាន?	☐☐☐☐ រៀល
35.h) តើអ្នកទុកដាក់ទឹកត្រីយ៉ាងដូចម្តេចនៅក្នុងផ្ទះ?	1. នៅលើធ្នើ នៅស៊ីតុណ្ហភាពធម្មតា (ក្នុងម្លប់) 2. នៅលើធ្នើ នៅស៊ីតុណ្ហភាពធម្មតា (ក្រោមកំដៅថ្ងៃ) 3. ក្នុងទូទឹកកក ឬធុងក្លាសេ 4. ផ្សេងៗ៖_____ ☐
35.i) តើតាមធម្មតាអ្នករៀបចំទឹកត្រីយ៉ាងដូចម្តេចសម្រាប់បរិភោគនៅក្នុងផ្ទះរបស់អ្នក?	1. ដាក់ក្នុងសម្ល 2. ដាក់ក្នុងឆា 3. ហូបផ្ទាល់ ☐ 4. ដាក់ក្នុងសម្លនិងហូបផ្ទាល់ 5. ដាក់ក្នុងឆានិងហូបផ្ទាល់ 6. ផ្សេងៗ៖_____

36. ឥឡូវខ្ញុំសូមសួរអ្នកអំពីរបៀបដែលគ្រួសារអ្នកបរិភោគទឹកត្រី	
36. a) នៅក្នុងគ្រួសាររបស់អ្នក តើអ្នកណាដែលបរិភោគទឹកត្រីច្រើនជាងគេបំផុត?	1. ខ្លួនឯង (ស្ត្រី) 2. ប្តី 3. ឃាយ 4. តា 5. ផ្សេងៗ-បញ្ជាក់:_____
36. b) ហេតុអ្វីបានជាគាត់ បរិភោគទឹកត្រីច្រើនជាងគេ?	1. គាត់ឃ្លានជាងគេបំផុត 2. គាត់ចូលចិត្តទឹកត្រីជាងគេបំផុត ☐ 3. គាត់ហូបច្រើនជាងគេ នៅពេលអាហារម្តងៗ 4. ផ្សេងៗ.....
36. c) នៅពេលដែលទឹកត្រីបានដាក់ក្នុងសម្ល តើសមាជិកពេញវ័យគ្រួសារទាំងអស់ហូបបរិមាណដូចគ្នាដែរឬទេ?	1= ចាស→ **សំណួរទី 37** ☐ 2= ទេ 3=មិនប្រើទឹកត្រីពេលធ្វើម្ហូប→ **សំណួរទី 37**
36. d) ប្រសិនបើមិនដូច ហេតុអ្វី?	១. អ្នកធ្វើការច្រើនហូបច្រើន ២. ប្តីហូបច្រើន ☐ ៣. អ្នកដែលចូលចិត្ត(សម្ល/ឆា/ខ....)ហូបច្រើនជាងគេ ៤. ផ្សេងៗ-បញ្ជាក់:_____
37.ឥឡូវខ្ញុំសូមសួរពីការគិតរបស់អ្នកស្តីពីផលិតផលបញ្ចូលជីវជាតិ។ ផលិតផលបញ្ចូលជីវជាតិគឺជាអាហារដែលបានបន្ថែមជីវជាតិ និងរ៉ែ ដើម្បីធ្វើអោយប្រសើរឡើងដល់សុខភាព និងការពារជម្ងឺ។ ឧទាហរណ៍អាហារដែលមានបញ្ចូលជីវជាតិ គឺអំបិលបញ្ចូលជាតិអ៊ីយ៉ូត ដែលសម្រាប់ការពារពកក។	
37. a) ជាទូទៅ តើអ្នកទិញអំបិលអ៊ីយ៉ូតដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 37c)** ☐
37.b) ប្រសិនបើចាស តើហេតុអ្វី? ពន្យល់ រួចទៅសំណួរ26.d	1. អ្នកដឹងថាវានឹងធ្វើអោយប្រសើរឡើងដល់សុខភាព 2. មានតែអំបិលនេះ ☐ 3. អ្នកដែលអាចជឿជាក់បាន (គ្រួសារ មេភូមិ បុគ្គលិកសុខភាព)បានណែនាំអោយប្រើ 4. អ្នកចូលចិត្តរសជាតិវា 5. ផ្សេងៗ.....
37. c) ប្រសិនបើទេ តើហេតុអ្វី?	1. វាមានតម្លៃថ្លៃ 2. មិនអាចរកអំបិលអ៊ីយ៉ូតបាន ☐ 3. អ្នកមិនចូលចិត្តរសជាតិ 4. មិនអាចរកទិញអំបិលអ៊ីយ៉ូតបាន 5. ផ្សេងៗ
37. d)តើអ្នកធ្លាប់ឮអំពីទឹកត្រីមានបញ្ចូលជាតិដែកដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 37h)** ☐

37. e) ប្រសិនបើធ្លាប់ តើឮពីកន្លែងណា?	១. ប្រពន្ធ័ផ្សព្វផ្សាយ(ទូរទស្សន៍/វិទ្យុ/កាសែត..) ២.ផ្ទាំងរូបភាពក្នុងភូមិ ☐ ៣.អ្នកដែលអាចជឿជាក់បាន (គ្រួសារ មេភូមិ បុគ្គលិកសុខភាព)បានណែនាំ ៤.ផ្សេងៗ-បញ្ជាក់:_____
37. f) តើអ្នកធ្លាប់ទិញទឹកត្រីបញ្ចូលជាតិដែកដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 37h)** ☐
37. g) ប្រសិនបើធ្លាប់ ហេតុអ្វី?	1. អ្នកដឹងថាវានឹងធ្វើអោយប្រសើរឡើងដល់សុខភាព 2. មានតែទឹកត្រីនេះ ☐ 3. អ្នកដែលអាចជឿជាក់បាន (គ្រួសារ មេភូមិ បុគ្គលិកសុខភាព)បានណែនាំអោយប្រើ 4. អ្នកចូលចិត្តរសជាតិវា 5. ផ្សេងៗ.....
37. h) ប្រសិនបើទឹកត្រីមានបញ្ចូលទាំងជាតិដែក និងជីវជាតិដែលអាចធ្វើអោយប្រសើរឡើងដល់សុខភាពអ្នក (ជីវជាតិ B1) តើអ្នកនឹងទិញវាដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 37j)** ☐
37. i) ប្រសិនបើទិញ តើហេតុអ្វី? **ពន្យល់ រួចទៅសំណួរ37.k)**	១.ធ្វើអោយសុខភាពប្រសើរឡើង ២.ណែនាំដោយអ្នកដែលអាចជឿជាក់បាន (គ្រួសារ មេភូមិ បុគ្គលិកសុខភាព)បានណែនាំអោយប្រើ ៣.ផលិតផលចាត់ទុកថាមានសុវត្ថភាព ☐ ៤.មានអ្នកភូមិទិញវា ៥.ផ្សេងៗ-បញ្ជាក់:_____
37. j) ប្រសិនបើមិនទិញ ហេតុអ្វី?**ពន្យល់ រួចទៅសំណួរ38**	
37. k) តើអ្នកនឹងចំណាយលុយលើសប៉ុន្មានដើម្បីទិញផលិតផលនេះ បើប្រៀបធៀបទៅនឹងទឹកត្រីដែលអ្នកតែងតែទិញ?	_____រៀល 1.មិនទិញទឹកត្រី

ផ្នែកទី៥៖ ចំណេះដឹងស្តីពីកង្វះជីវជាតិB1 និងជម្ងឺបេរីបេរី	
38. តើអ្នកធ្លាប់ឮអំពីជីវជាតិB1 ឬហ្សាមីន ដែរឬទេ?	1= ចាស 2= ទេ ☐
39. តើអ្នកធ្លាប់ឮអំពីបញ្ហាកង្វះជីវជាតិB1 ឬជំងឺបេរីបេរីដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 43** ☐
40. តើអ្នកដឹងអំពី អាការៈរោគនៃបញ្ហាកង្វះជីវជាតិB1 ឬជំងឺបេរីបេរីចំពោះទារកអាយុតិចជាង៦ខែដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 43** ☐
41. តើការៈរោគនៃបញ្ហាកង្វះជីវជាតិB1ឬជំងឺបេរីបេរី ចំពោះទារកអាយុតិចជាង៦ខែមានអ្វីខ្លះ?	.....

42. តើអ្នកព្យាបាលបញ្ជាកង្វះជីវជាតិB1ឬជំងឺបេរីបេរីចំពោះទារកអាយុតិចជាង៦ខែ ដោយរបៀបណា?	.....
43. តើទារកគួរតែបំបៅទឹកដោះម្តាយតែ១មុខគត់ ដល់អាយុប៉ុន្មាន (បំបៅតែទឹកដោះម្តាយ មិនលាយទឹក ទឹកដូង ឬក៏អាហារអ្វីផ្សេងទៀតឡើយ)?	1= ចាស 2= ទេ → **សំណួរទី 46** ☐
44. តើកុមារគួរតែទទួលអាហារបន្ថែមក្រៅពីទឹកដោះម្តាយ នៅអាយុប៉ុន្មាន? (អាហារដែលផ្តល់អោយកុមារបន្ថែមទៅលើទឹកដោះ)	
45. តើកុមារគួរតែបន្តបំបៅដោយទឹកដោះម្តាយ ជាមួយនឹងការផ្តល់អាហារផ្សេងៗទៀតដល់អាយុប៉ុន្មាន?	
46. តើអាហារអ្វីខ្លះដែលកុមារគួរតែបរិភោគជាលើកដំបូងក្រៅពីទឹកដោះម្តាយ?	1. _____ 2. _____ 3. _____
47. តើនៅពេលណាដែលកុមារគួរតែចាប់ផ្តើមបរិភោគអាហារគ្រួសារ?	.....

ផ្នែកទី 6 ៖ ការវាស់កម្ពស់ និងថ្លឹងទម្ងន់	
48. កម្ពស់របស់អ្នកចូលរួម	១) ☐☐☐.☐ ស.ម ២) ☐☐☐.☐ ស.ម ៣) ☐☐☐.☐ ស.ម
49. ការថ្លឹងទម្ងន់របស់អ្នកចូលរួម	១) ☐☐.☐ គ.ក ២) ☐☐.☐ គ.ក ៣) ☐☐.☐ គ.ក

ENDLINE QUESTIONNAIRE
PREGNANT COHORT
Thiamin fortified fish sauce as a means of combating infantile beriberi in rural Cambodia

CONFIDENTIAL
All information collected in this survey is strictly confidential and will be used for statistical purposes only.

IDENTIFICATION INFORMATION	
Geographic Identification	**Interviewer Record**
Province: _____PREY VENG_____ District: _____ Commune: _____ Village: _____ Subject ID: __ __ __ __ __	Interviewer: ___ ___ Name: _____ Signature: _____ Remarks:
Date of Interview: (DD/MM/YYYY) ___ ___/ ___ ___/ ___ ___ ___ ___	

MODULE 1: PARTICIPANT INFORMATION	
1. How many people currently live in your household (defined as eating from the same pot each day)?	_____ people
2. How many antenatal visits did you attend during your pregnancy?	_____ visits
3. Where did you give birth to your child?	1. local health centre 2. district hospital 3. local birth attendant in your village 4. in your home, without a birth attendant 5. private clinic or hospital ____ 6. other: _____
4. How many weeks pregnant were you when you delivered?	_____ weeks 88 = unknown
5. Did you give birth to a girl or boy?	1. Girl

	2. Boy ____
6. Did you take any deworming tablets during your pregnancy?	1. Yes 2. No ____
7. Did you take any iron folic acid tablets during your pregnancy?	1. Yes 2. **No → code, then proceed to Q9** ____
8. How many iron folic acid tablets did you take throughout your pregnancy?	_____ tablets
9. Are you currently breastfeeding?	1. Yes 2. **No → code, then proceed to Q12** ____
10. How old is the child you are currently breastfeeding?	_____ months
11. Are you currently exclusively breastfeeding this child (feeding only breast milk, no water, coconut water, rice, or other foods)?	1. **Yes → code, then proceed to Q13** 2. No ____
12. At what age did this child start receiving complementary foods (first foods that are consumed in addition to breast milk)?	_____ months
13. Under what conditions is fish sauce stored in your home?	1. on a shelf at room temperature (in the shade) 2. on a shelf at room temperature (in the sun) 3. in a refrigerator, or in a cool box with ice 4. other - specify: _____ _____
14. During this study, did you share or sell any of the fish sauce provided to you?	1. Yes **2. No → code, then proceed to Q16** ____
15. If yes, who did you sell or share this fish sauce with?	1. family/relatives living outside the household 2. neighbors or friends 3. other: _____ _____
16. During the past 6 months, how many bottles of fish sauce did your household typically consume in a two week period?	_____ . _____ bottles
17. During the past 6 months, did you leave your village for longer than 2 consecutive weeks? (For example, to work in another province, to live with relatives, etc)	1. Yes **2. No → code, then proceed to Q19** ____
18. If yes, how many months (total) were you living away from your home in the past six months?	_____ . _____ months

MODULE 2: FOOD INTAKE

19. I would like to ask you about the foods and drinks that you may have consumed **yesterday** during the day or night. I want to know how often you ate the food, approximately how much of the food you ate in a typical serving, and how it was consumed.

Food Type	**Consumed yesterday**	**If yes, how often?**	**Amount per typical serving (g or mL)**	**Consumed alone, or with other foods?**
a) White Rice, and	1. Yes 2. No → code, then	1. Once 2. Twice		1. Consumed alone 2. Consumed with other foods;

white rice borbor	proceed to next row _____	3. Three times 4. >3 times _____		describe: _____
b) Bread, brown rice, noodles, porridge, or other foods made from grains? (**Other than white rice**.)	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
c) Pumpkin, carrots, squash, or sweet potatoes that are yellow or orange inside?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
d) White potatoes, white yams, manioc, cassava, or any other foods made from roots?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
e) Dark leafy green vegetables (eg. kang kong)	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
f) Ripe mangoes, papayas or any other yellow or orange fruits?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
g) Other fruits or vegetables?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
h) Liver, kidney, heart, or other organ meats?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
i) Meat, such as beef, pork, lamb, goat, chicken, or duck?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
j) Eggs?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
k) Fresh or dried fish and shellfish (including snails,	1. Yes 2. No → code, then proceed to next row	1. Once 2. Twice 3. Three times		1. Consumed alone 2. Consumed with other foods; describe:

crab, squid)?	_____	4. >3 times _____		_____
l) Foods made from beans, peas, lentils, or nuts?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
m) Milk, cheese or other foods made from milk?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
n) Foods made with oil, fat, or butter?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
o) Snake, frog, rats, or insects?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____
p) Sugary foods such as pastry, cakes, chocolates, sweets, or candies?	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Consumed alone 2. Consumed with other foods; describe: _____

20. How many meals and snacks did you consume yesterday?	a) _____ meals, **and** b) _____ snacks
21. Was yesterday's food intake typical/usual for you?	**1. Yes→ code, then proceed to Q23** 2. No ____
22. If no, why was it not typical/usual?	1. I was ill 2. I was not hungry 3. There was not enough food ____ 4. It was a celebration (ate more or differently) 5. Other – specify:_____ ____
23. Who is primarily responsible for food preparation in your household?	1. mother 2. father 3. grandmother 4. grandfather 5. male children ____ 6. female children 7. other – specify:_____
24. During your pregnancy, did you tend to eat more, less, or the same amount of food as before? **If responded 3) same amount of food as before,**	1. more food 2. less food 3. same amount of food as before

code and proceed to Q26	4. other: _____ ____
25. How many more/less meals and snacks did you typically consume?	a) _____ meals, **and** b) _____ snacks
26. While you were (are) breastfeeding, did/do you tend to eat more, less, or the same amount of food as before? **If responded 3) same amount of food as before, code and proceed to Q28**	1. more food 2. less food 3. same amount of food as before 4. other: _____ ____
27. How many more/less meals and snacks did/do you typically consume?	a) _____ meals, **and** b) _____ snacks

MODULE 3: FISH SAUCE CONSUMPTION

28. Now I would like to ask you about your fish sauce consumption. During the **past week**, did you consume fish sauce …

Food Type	Consumed in last week	If yes, how often?	Amount of fish sauce per typical serving (mL)	Describe consumption/ food preparation
Fish sauce as a condiment	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____		1. fish sauce **alone** in small bowl 2. fish sauce with chilies/garlic/MSG/lime/lemon in small bowl 3. other – specify: _____ _____
Fish sauce, in the common pot	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____		1. in soup 2. In stir fry 3. In khor 4. other – specify: _____ _____
Teuk Trey Ph'aem, or Teuk Trey Koh Kong	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____		1. Teuk Trey Ph'aem 2. Teuk Trey Koh Kong 3. other:_____ _____
Fish sauce with green mango	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____		
Fish sauce with tamarind	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____		1. ripe tamarind 2. young tamarind 3. other: _____ _____

Teuk Kroeung	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____		
Other – specify: _____	1. Yes 2. No → code, then proceed to next row _____	1. 1-3 times per week 2. 4-6 times per week 3. 7-9 times per week 4. 10+ times per week _____		

29. During the **past day** (yesterday, during the day and at night), did you consume fish sauce …

Food Type	**Consumed yesterday**	**If yes, how often?**	**Amount of fish sauce per typical serving (mL)**	**Describe consumption/ food preparation**
Fish sauce as a condiment	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. fish sauce **alone** in small bowl 2. fish sauce with chilies/garlic/MSG/lime/lemon in small bowl 3. other – specify: _____ _____
Fish sauce, in the common pot	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. in soup 2. In stir fry 3. In khor 4. other – specify: _____ _____
Teuk Trey Ph'aem, or Teuk Trey Koh Kong	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. Teuk Trey Ph'aem 2. Teuk Trey Koh Kong 3. other:_____ _____
Fish sauce with green mango	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		
Fish sauce with tamarind	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		1. ripe tamarind 2. young tamarind 3. other: _____ _____
Teuk Kroeung	1. Yes 2. No → code, then proceed to next row _____	1. Once 2. Twice 3. Three times 4. >3 times _____		
Other – specify:	1. Yes 2. No → code, then proceed to next row	1. Once 2. Twice 3. Three times		

_____	_____	4. >3 times _____		

30. Now I would like to ask you about your household's fish sauce consumption patterns over the study period (last 6 months).

30. a) During the study period (last 6 months), did your household's fish sauce consumption change from usual? (Compared to before the study)	1. Yes 2. **No → code, and proceed to Q31** _____
30. b) If yes, has it increased or decreased slightly or a lot?	1. Increased slightly 2. Increased a lot 3. Decreased slightly 4. Decreased a lot ____
30. c) Why did it change?	1. Fish sauce was provided for free 2. Fish sauce tasted delicious 3. Fish sauce did **not** taste delicious 4. Other – specify:_____ ____
31. I would now like to ask you about your perceptions of the fish sauce you have been consuming over the study period (last 6 months).	
31. a) Did you like the taste of the fish sauce you consumed throughout the study period?	1. Yes 2. **No → code, and proceed to Q31. c)** _____
31.b) If yes, why? **Explain, then proceed to Q31.d)**	1. Tasted delicious 2. Tasted like the fish sauce I normally buy 3. Tasted like the fish sauce I normally make 4. Other – specify:_____ ____
31. c) If no, why?	1. Tasted too salty 2. Tasted different from my usual fish sauce 3. Tasted like medicine 4. Other – specify:_____ ____
31. d) Was the colour of the fish sauce acceptable?	**1. Yes → code, and proceed to Q31.f)** 2. No _____
31. e) If no, why not?	1. Too dark 2. Too light 3. Other – specify:_____ ____
31. f) In the future, if there were the possibility to purchase the study fish sauce in your village, would you choose purchase it?	1. Yes 2. No → **code, and proceed to Q31.i)** _____
31. g) If yes, why?	1. Tasted delicious 2. I think it improves my family's health 3. Other – specify:_____ ____
31. h) How much would you be willing to pay for one bottle (750 mL) of this study fish sauce?	_____ Riel → **write, and proceed to Q23**
31. i) If no, why not?	1. Tasted too salty

	2. Tasted different from my usual fish sauce 3. Tasted like medicine 4. Other – specify:_____ ____
32. I would now like to ask you about how your family eats fish sauce.	
32. a) In your household, who consumes the most fish sauce?	1. mother 2. father 3. grandmother 4. grandfather 5. other - specify: _____ _____
32. b) Why does this person consume the most fish sauce?	1. they have the largest appetite 2. they prefer fish sauce the most 3. they are fed the largest portion of each meal 4. other - specify: _____ _____
32. c) When fish sauce is consumed from the common pot, do all adult members of your household consume the same amount?	1. **Yes → code, then proceed to Q33** 2. No 3. fish sauce not used in common pot → **code, and proceed to Q24** _____
32. d) If no, why?	1. person who works the most eats more 2. husband eats more 3. person who prefers the food from the common pot the most eats more 4. other - specify: _____ _____
32. e) When you purchase fish sauce at market, how much do you usually pay for one 750 mL bottle?	_____ Riel or **88** if do not purchase fish sauce
33. I would now like to ask your opinion about fortified products. A fortified product is a food that has added vitamins or minerals to improve health and prevent disease. One example of a fortified food is iodized salt, which is fortified to prevent goiters.	
33. a) Have you heard of iron-fortified fish sauce?	1. Yes 2. **No → code, then proceed to Q33f)** _____
33. b) If yes, from where did you hear about iron-fortified fish sauce?	1. media (TV, radio, newspapers) 2. posters in the village 3. heard from a trusted person (family member, village chief, health professional) 4. Other - specify: _____ _____
33. c) Have you purchased iron fortified fish sauce?	1. Yes 2. **No → code, then proceed to Q33e)** _____
33. d) If yes, why? **Explain, then proceed to Q33.f)**	1. because you know it will improve health 2. because it is the only fish sauce available 3. because a trusted person (family member, village chief, health professional) recommended it 4. because you prefer the taste

	5. other – specify: _____ _____
33. e) If no, why?	1. because it is expensive 2. because it is not available 3. because you do not like the taste 4. Because you do not like the colour 5. Other: _____ _____
33. f) If a fish sauce became available that contained both iron and a vitamin that could improve your health (vitamin B_1), would you purchase this product?	1. Yes 2. **No → code, then proceed to 33.h)** _____
33. g) If yes, why? **Explain, then proceed to Q33i)**	1. it could improve health 2. It may be recommended by a trusted person (family member, village chief, health professional) 3. it is deemed safer and of higher quality because it's likely more carefully regulated 4. other people may purchase it 5. other: _____ _____
33. h) If no, why? **Explain, then proceed to Q34**	1. it will likely be more expensive 2. she **likes to** make fish sauce herself 3. she **must** make fish sauce herself because she doesn't have money to buy fish sauce 4. other: _____ _____
33. i) How much **more** money would you be willing to pay for this product (as compared to what you usually spend on fish sauce)?	_____ Riel, OR

MODULE 4: KNOWLEDGE OF THIAMIN DEFICIENCY, BERIBERI, AND INFANT AND YOUNG CHILD FEEDING (IYCF)	
34. Have you ever heard of vitamin B_1, also known as thiamin?	1. Yes 2. No _____
35. Have you ever heard of vitamin B_1 (thiamin) deficiency, or beriberi?	1. Yes 2. **No → code, then proceed to Q41** _____
36. Do you know any symptoms of vitamin B_1 (thiamin) deficiency or beriberi in infants less than 6 months old?	1. Yes 2. **No → code, then proceed to Q41** _____
37. What are the symptoms of vitamin B_1 (thiamin) deficiency or beriberi in **infants less than 6 months old**? CHECK ALL THAT APPLY	a. rapid breathing _____ b. rapid heart rate _____ c. edema _____ d. vomiting _____ e. little urine _____ f. convulsions _____ g. distinctive cry with no sound _____ h. loss of appetite _____ i. other: _____ _____
38. How do you prevent or treat vitamin B_1	a. mother should eat foods rich in thiamin _____ b. mother should eat a thiamin-fortified food (eg. fish sauce) _____

(thiamin) deficiency or beriberi in **infants less than 6 months old**? CHECK ALL THAT APPLY	c. mother should take a thiamin supplement (pill) _____ d. baby should eat foods rich in thiamin _____ e. baby should eat a thiamin-fortified food (eg. fish sauce) _____ f. baby should take a thiamin supplement (pill) _____ g. other: _____ _____
39. Can you name some foods that are good sources of thiamin?	1. Yes 2. **No → code, and proceed to Q41** _____
40. If yes, please name some foods high in thiamin. CHECK ALL THAT APPLY	a. **brown** rice _____ b. legumes, like beans and peas _____ c. pork _____ d. organ meats _____ e. soybeans, tofu, and/or soy products _____ f. other: _____ _____
41. Until what age should infants be **exclusively** breastfed (fed **only** breast milk, not water, coconut water, or any foods)?	_____ months 88 = unknown
42. At what age should children start receiving complimentary foods (foods that are provided to children in addition to breast milk)?	_____ months 88 = unknown
43. Until what age should children **continue** to be breastfed while also eating other foods?	_____ months 88 = unknown
44. What are the first foods a child should eat, other than breast milk? CHECK ALL THAT APPLY	a. tinned porridge _____ b. plain porridge _____ c. enriched borbor _____ d. white rice _____ e. steamed rice with salt/meat/fish sauce/soup/other _____ f. mushed rice with salt/meat/fish sauce/soup/other _____ g. yellow or orange fruit or vegetables _____ h. egg _____ i. other: _____ _____
45. When should a child start eating foods from the family pot?	_____ months 88 = unknown

MODULE 5: PERCIEVED HEALTH BENEFITS	
46. Since the beginning of the study (last 6 months) have you seen a change in energy or activity levels of yourself or your child?	1. Yes 2. No **No → code, then proceed to Q49** _____
47. If yes, please describe regarding yourself.	
48. If yes, please describe regarding your child.	
49. Since the beginning of the study (last 6 months) have you seen a change in your health or the health of your child?	1. Yes 2. **No → code, then proceed to Q41** _____
50. If yes, please describe regarding yourself.	
51. If yes, please describe regarding your child.	

Thank you so much for your time!

បញ្ជីសំណួរការអង្កេតបញ្ចប់

សម្រាប់ស្ត្រីមានផ្ទៃពោះ

ទឹកត្រីបញ្ចូលជីវជាតិB1 ជាមធ្យោបាយក្នុងការទប់ស្កាត់ជម្ងឺបេរីបេរីចំពោះទារក នៅតាមជនបទប្រទេសកម្ពុជា

ការសំងាត់

រាល់ព័ត៌មានដែលប្រមូលបាននៅក្នុងការសិក្សាស្រាវជ្រាវនេះនឹងត្រូវបានរក្សាជាការសំងាត់ និងប្រើប្រាស់ក្នុងគោល បំណងបៃបស្ថិតិប៉ុណ្ណោះ ។

ព័ត៌មានកំណត់សំគាល់	
កំណត់សំគាល់ភូមិសាស្ត្រ	**កំណត់សំគាល់អ្នកសម្ភាសន៍**
ខេត្ត: ព្រៃវែង ស្រុក: ..... ឃុំ: ..... ភូមិ៖ ..... លេខសំគាល់សំណាក: ☐☐☐☐☐	អ្នកសម្ភាសន៍ ឈ្មោះ ..... ហត្ថលេខា: ..... កំណត់សម្គាល់ .....
កាលបរិច្ឆេទការសម្ភាសន៍: (ថ្ងៃ /ខែ /ឆ្នាំ) __/__/____	

ផ្នែកទី 1 ៖ ព័ត៌មានអ្នកចូលរួម	
1. បច្ចុប្បន្ននេះ តើមានមនុស្សប៉ុន្មាននាក់រស់នៅក្នុងផ្ទះរបស់អ្នក? (រាប់អ្នកដែលហូបបាយជាមួយគ្នា រាល់ថ្ងៃ)	☐☐ នាក់
2. តើអ្នកបានទៅពិនិត្យផ្ទៃពោះប៉ុន្មានដង?	☐☐ ដង
3. តើអ្នកបានទៅសម្រាលកូននៅកន្លែងណា?	1. មណ្ឌលសុខភាព 2. មន្ទីរពេទ្យស្រុក ☐ 3. ឆ្មបក្នុងភូមិ 4. នៅផ្ទះ ដោយគ្មានឆ្មប 5. មន្ទីរពេទ្យឬគ្លីនិកឯកជន 6. ផ្សេងៗ.....
4. តើអ្នកសម្រាល នៅពេលមានផ្ទៃពោះបានប៉ុន្មានសប្តាហ៍?	☐☐ សប្តាហ៍ 88=មិនដឹង

5. តើអ្នកកើតបានកូនស្រីឬប្រុស?	1=ស្រី ☐ 2=ប្រុស
6. តើអ្នកបានលេបថ្នាំគ្រាប់ទម្លាក់ព្រូនដែរឬទេ ក្នុងអំឡុងពេលអ្នកមានផ្ទៃពោះ?	1= ចាស 2= ទេ ☐
7. តើអ្នកបានលេប គ្រាប់ថ្នាំជាតិដែក/ហ្វូលីតអាស៊ីតដែរឬទេ ក្នុងអំឡុងពេលមានផ្ទៃពោះនេះ?	1= ចាស ☐ 2= ទេ → **សូមរំលងទៅសំណួរ9**
8. តើអ្នកបានលេប គ្រាប់ថ្នាំជាតិដែក/ហ្វូលីតអាស៊ីតចំនួនប៉ុន្មានគ្រាប់ ក្នុងអំឡុងពេលមានផ្ទៃពោះនេះ?	☐☐ គ្រាប់
9. បច្ចុប្បន្ននេះ តើអ្នកកំពុងបំបៅកូនដោយទឹកដោះម្តាយដែរឬទេ?	1= ចាស ☐ 2= ទេ → **រំលងទៅសំណួរទី12**
10. តើកូនដែលអ្នកកំពុងបំបៅដោះនោះអាយុប៉ុន្មានខែ?	☐☐ ខែ
11. បច្ចុប្បន្ននេះ តើអ្នកបំបៅកូននោះដោយទឹកដោះម្តាយតែមួយមុខគត់ (ទឹកដោះម្តាយតែមួយមុខគត់ គ្មានលាយទឹក ទឹកដូង បាយ ឬអាហារដទៃទៀត)ដែរឬទេ?	1= ចាស→ **សូមរំលងទៅសំណួរ13** 2= ទេ ☐
12. តើកូនរបស់អ្នកបានចាប់ផ្តើមទទួលអាហារបន្ថែមនៅអាយុប៉ុន្មាន (អាហារដំបូងដែលបន្ថែមពីលើទឹកដោះម្តាយ)?	ខែ ☐☐
13. តើទឹកត្រីទុកដាក់យ៉ាងដូចម្តេច នៅក្នុងផ្ទះរបស់អ្នក?	1= នៅលើធ្នើ ក្នុងសីតុណ្ហភាពធម្មតា (ក្នុងម្លប់) 2= នៅលើធ្នើ ក្នុងសីតុណ្ហភាពធម្មតា (ត្រូវកំដៅថ្ងៃ) 3= ក្នុងទូរទឹកកក ឬក្នុងធុងដែលមានទឹកកក ☐ 4= ផ្សេងៗ- បញ្ជាក់.....
14. ក្នុងអំឡុងពេលការសិក្សានេះ តើអ្នកបានចែករំលែក ឬលក់ទឹកត្រីដែលគម្រោងបានចែកអោយអ្នកដែរឬទេ?	1= ចាស 2= ទេ → **រំលងទៅសំណួរទី16** ☐
15. ប្រសិនបើចាស តើអ្នកបានលក់ឬចែកទឹកត្រីនោះទៅអ្នកណា?	1= សាច់ញាតិ/បងប្អូនដែលរស់នៅផ្ទះផ្សេង ☐ 2= អ្នកជិតខាង ឬមិត្តភក្តិ 3= ផ្សេងៗ៖.....
16. ក្នុងអំឡុងពេល៦ខែកន្លងមកនេះ តើជាធម្មតាគ្រួសាររបស់អ្នកបានបរិភោគទឹកត្រីអស់ប៉ុន្មានដប សម្រាប់រយៈពេលពីរសប្តាហ៍?	☐.☐ ដប
17. ក្នុងអំឡុងពេល៦ខែកន្លងមកនេះ តើអ្នកបានចាកចេញពីភូមិយូរជាង៧ថ្ងៃជាប់គ្នាដែរឬទេ? (ឧ. ទៅធ្វើការនៅខេត្តផ្សេង ទៅរស់នៅជាមួយសាច់ញាតិ។ល។)	1= ចាស ☐ 2= ទេ → **រំលងទៅសំណួរទី19**
18. ប្រសិនបើចាស ក្នុងអំឡុងពេល៦ខែកន្លងមកនេះ តើអ្នករស់នៅឆ្ងាយពីផ្ទះរយៈសរុបពេលប៉ុន្មានខែ ?	☐.☐ ខែ

ផ្នែកទី 2: ការបរិភោគអាហារ

19.ខ្ញុំសូមសួរអ្នកអំពីអាហារ និងភេសជ្ជៈ ដែលអ្នកបានបរិភោគ **កាលពីម្សិលមិញ** នៅពេលថ្ងៃ ឬពេលយប់។ ខ្ញុំចង់ដឹងពីចំនួនដង បរិមាណអាហារ និងរបៀបដែលអ្នកបានបរិភោគ។

ប្រភេទអាហារ	បានបរិភោគកាលពីម្សិលមិញ	បើបាន ញឹកញាប់ប៉ុណ្ណា?	បរិមាណក្នុងពេលបរិភោគម្តង (ក្រាម ឬមីលីលីត្រ)	បរិភោគតែមួយមុខ ឬលាយជាមួយអាហារផ្សេងទៀត?
a) បាយ និងបបរអង្ករសម្រិត	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
b) នំប៉័ង/បាយ/មី/បបរ ឬអាហារធ្វើពីគ្រាប់ធញ្ញជាតិផ្សេងទៀត? (ក្រៅពីអង្ករសម្រិត)	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
c) ល្ពៅ ការ៉ុត ឬដំឡូងជ្វាសាច់ពណ៌លឿង ឬពណ៌ទឹកក្រូច	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
d) ដំឡូងជ្វាសាច់ពណ៌ស ដំឡូងមី ត្រាវសាគូ ឬអាហារផ្សេងៗធ្វើពីមើម	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
e) បន្លែស្លឹកពណ៌បៃតងចាស់ (ឧ. ត្រកួន)	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
f) ស្វាយទុំ ល្ពៅទុំ ឬផ្លែឈើពណ៌លឿងទុំដទៃទៀត?	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
g) បន្លែ ឬផ្លែឈើដទៃទៀត?	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
h) ថ្លើម ក្រលៀន បេះដូង ឬគ្រឿងក្នុងដទៃទៀត?	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....

i) សាច់សត្វ ដូចជាសាច់គោ សាច់ជ្រូក សាច់ចៀម សាច់ពពែ សាច់មាន់ សាច់ទា?	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
j) ស៊ុត?	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
k) ត្រីស្រស់ ឬត្រីងៀត ខ្យង ខ្ចៅ ក្តាម មឹក?	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
l) អាហារធ្វើពីសណ្តែក ឬសណ្តែកបារាំងឬសណ្តែកដី	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
m) ទឹកដោះគោ ឈីស ឬអាហារធ្វើពីទឹកដោះគោ?	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
n) អាហារធ្វើពីប្រេង ខ្លាញ់ ឬប៊ឺរ?	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
o) ពស់ កង្កែប កណ្តុរ ឬសត្វល្អិត?	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....
p) អាហារមានជាតិផ្អែម (ស្ករ) ដូចជាស្ករគ្រាប់ សុកក្វឡា នំ បង្អែម?	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= តែមួយមុខ 2= លាយជាមួយអាហារផ្សេងទៀត .....

20. កាលពីម្សិលមិញ តើអ្នកបានបរិភោគអាហារពេល ឬ អាហារក្រៅពេលប៉ុន្មានដង?	អាហារពេល ☐☐ អាហារក្រៅពេល ☐☐
21. តើអ្នកតែងតែញ៉ាំធម្មតាដូចនេះ ដែរឬទេ?	1= ចាស→ **សំណួរទី 23** ☐ 2= ទេ
22. ប្រសិនបើមិនធម្មតា តើខុសគ្នាដូចម្តេច? **សូមគូសយកចម្លើយដែលបានឆ្លើយទាំងអស់** **កូដ 0=ទេ 1=ចាស**	1. ឈឺ ☐ 2. មិនឃ្លាន ☐ 3. គ្មានអាហារគ្រប់គ្រាន់ ☐ 4. មានពិធី (ហូបច្រើន ឬផ្សេង) ☐ 5. ផ្សេងៗ-បញ្ជាក់: _____

23. អ្នកណាជាអ្នកទទួសខុសត្រូវចម្បងក្នុងការរៀបចំអាហារក្នុងគ្រួសាររបស់អ្នក?	1. ម្តាយកុមារ 2. ឪពុកកុមារ ☐ 3. យាយកុមារ 4. តាកុមារ 5. កូនប្រុស 6. កូនស្រី 7. ផ្សេងៗ-បញ្ជាក់:_____
24. ក្នុងអំឡុងពេលមានផ្ទៃពោះ តើអ្នកហូបច្រើនជាង តិចជាង ឬដូចពេលមិនទាន់មានផ្ទៃពោះ? **ប្រសិនបើឆ្លើយចំលើយ៣) ដូចមុន សូមរំលងទៅសំណួរ២៦**	1. ហូបច្រើនជាងមុន 2. ហូបតិចជាងមុន ☐ 3. ដូចមុន 4. ផ្សេងៗ.....
25. តើអ្នកបានបរិភោគអាហារពេល និងអាហារក្រៅពេលតិច/ច្រើនជាងប៉ុន្មានដង?	a) អាហារពេល ☐ b) អាហារក្រៅពេល ☐
26. ក្នុងអំឡុងពេលអ្នកបំបៅដោះកូន តើអ្នកហូបច្រើនជាងតិចជាង ឬដូចពេលមុន? **ប្រសិនបើឆ្លើយចំលើយ៣) ដូចមុន សូមរំលងទៅសំណួរ២៨**	1. ហូបច្រើនជាងមុន 2. ហូបតិចជាងមុន ☐ 3. ដូចមុន 4. ផ្សេងៗ.....
27. តើអ្នកបានបរិភោគអាហារពេល និងអាហារក្រៅពេលតិច/ច្រើនជាងប៉ុន្មានដង?	c) អាហារពេល ☐ d) អាហារក្រៅពេល ☐

ផ្នែកទី 3 ៖ទឹកត្រី

28. ឥឡូវ ខ្ញុំសូមសួរអ្នកអំពីការបរិភោគទឹកត្រីរបស់អ្នក។ កាលពីមួយអាទិត្យកន្លងមកនេះ តើអ្នកបានបរិភោគទឹកត្រី..... ដែរឬទេ?

ប្រភេទអាហារ	បានបរិភោគកាលពីមួយអាទិត្យកន្លងមក	បើបាន ញឹកញាប់ប៉ុណ្ណា?	បរិមាណទឹកត្រីក្នុងពេលបរិភោគម្តង (មីលីលីត្រ)	ពិពណ៌នាការបរិភោគ/ការរៀបចំអាហារ
ហូបទឹកត្រីផ្ទាល់	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= 1-3ដងក្នុងមួយសប្តាហ៍ ☐ 2= 4-6ដងក្នុងមួយសប្តាហ៍ 3= 7-9ដងក្នុងមួយសប្តាហ៍ 4= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍		1.ទឹកត្រីសុទ្ធ 2.ទឹកត្រីលាយជាមួយម្ទេសខ្ទឹមស ប៊ីចេង ក្រូចឆ្មារ 3.ផ្សេងៗ.....
ទឹកត្រីដាក់ក្នុងម្ហូប	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= 1-3ដងក្នុងមួយសប្តាហ៍ ☐ 2= 4-6ដងក្នុងមួយសប្តាហ៍ 3= 7-9ដងក្នុងមួយសប្តាហ៍ 4= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍		1. ដាក់ក្នុងសម្ល 2. ដាក់ក្នុងឆា 3. ដាក់ក្នុងខ 4. ផ្សេងៗបញ្ជាក់.....

ទឹកត្រីផ្អែម ឬ ទឹកត្រីកោះកុង	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= 1-3ដងក្នុងមួយសប្តាហ៍ 2= 4-6ដងក្នុងមួយសប្តាហ៍ 3= 7-9ដងក្នុងមួយសប្តាហ៍ 4= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐		1= ទឹកត្រីផ្អែម 2= ទឹកត្រីកោះកុង 3=ផ្សេងៗបញ្ជាក់.....
ទឹកត្រីជាមួយស្វាយ	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= 1-3ដងក្នុងមួយសប្តាហ៍ 2= 4-6ដងក្នុងមួយសប្តាហ៍ 3= 7-9ដងក្នុងមួយសប្តាហ៍ 4= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐		
ទឹកត្រីជាមួយអំពិល	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= 1-3ដងក្នុងមួយសប្តាហ៍ 2= 4-6ដងក្នុងមួយសប្តាហ៍ 3= 7-9ដងក្នុងមួយសប្តាហ៍ 4= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐		1= អំពិលទុំ 2= ទំពិលខ្ចី 3=ផ្សេងៗបញ្ជាក់.....
ទឹកគ្រឿង	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= 1-3ដងក្នុងមួយសប្តាហ៍ 2= 4-6ដងក្នុងមួយសប្តាហ៍ 3= 7-9ដងក្នុងមួយសប្តាហ៍ 4= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐		
ផ្សេងៗ-បញ្ជាក់: _____	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= 1-3ដងក្នុងមួយសប្តាហ៍ 2= 4-6ដងក្នុងមួយសប្តាហ៍ 3= 7-9ដងក្នុងមួយសប្តាហ៍ 4= ចាប់ពី១០ដងក្នុងមួយសប្តាហ៍ ☐		

29. កាលពីម្សិលមិញ (ទាំងពេលយប់ និងពេលថ្ងៃ) តើអ្នកបានបរិភោគទឹកត្រី.....ដែរឬទេ?

ប្រភេទអាហារ	**បានបរិភោគកាលពីម្សិលមិញ**	**បើបាន ញឹកញាប់ប៉ុណ្ណា?**	**បរិមាណទឹកត្រី ក្នុងពេលបរិភោគម្តង (មីលីលីត្រ)**	**ពិពណ៌នាការបរិភោគ/ ការរៀបចំអាហារ**
ហូបទឹកត្រីផ្ទាល់	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង 3= បីដង 4= ច្រើនជាងបីដង ☐		1. ទឹកត្រីសុទ្ធ 2. ទឹកត្រីលាយជាមួយម្ទេស ខ្ទឹមស បីរចេង ក្រូចឆ្មារ 3. ផ្សេងៗ.....
ទឹកត្រីដាក់ក្នុងម្ហូប	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង 3= បីដង 4= ច្រើនជាងបីដង ☐		1. ដាក់ក្នុងសម្ល 2. ដាក់ក្នុងឆា 3. ដាក់ក្នុងខ 4. ផ្សេងៗបញ្ជាក់.....
ទឹកត្រីផ្អែម ឬ ទឹកត្រីកោះកុង	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង 3= បីដង 4= ច្រើនជាងបីដង ☐		1= ទឹកត្រីផ្អែម 2= ទឹកត្រីកោះកុង 3=ផ្សេងៗបញ្ជាក់.....
ទឹកត្រីជាមួយស្វាយខ្ចី	១. ចាស ២. ទេ → ជូរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង 3= បីដង 4= ច្រើនជាងបីដង ☐		

ទឹកត្រីជាមួយអំពិល	១. ចាស ២. ទេ → ជួរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		1= អំពិលទុំ 2= ទំពិលខ្ចី 3=ផ្សេងៗបញ្ជាក់.....
ទឹកគ្រឿង	១. ចាស ២. ទេ → ជួរបន្ទាប់ ☐	1= ម្តង 2= ពីរដង ☐ 3= បីដង 4= ច្រើនជាងបីដង		

ឥឡូវនេះ ខ្ញុំសូមសួរអ្នកអំពីការបរិភោគទឹកត្រីនៅក្នុងគ្រួសាររបស់អ្នក ក្នុងអំឡុងពេលការសិក្សា (៦ខែកន្លងមក)	
30 a) ក្នុងអំឡុងពេលការសិក្សា (៦ខែកន្លងមក)តើការបរិភោគទឹកត្រីក្នុងគ្រួសារអ្នក មានការផ្លាស់ប្តូរខុសពីធម្មតាដែរឬទេ? (ប្រៀបធៀបមុនពេលចូលរួមគម្រោង)	1= ចាស 2= ទេ → **សំណួរទី 31** ☐
30b) ប្រសិនបើចាស តើវាកើនឡើង ឬថយចុះ បន្តិចបន្តួច ឬច្រើន?	1= កើនឡើងបន្តិចបន្តួច 2= កើនឡើងច្រើន 3= ថយចុះតិចតួច ☐ 4= ថយចុះច្រើន
30c) ហេតុអ្វីបានជាវាផ្លាស់ប្តូរ?	1= បានទទួលទឹកត្រីដោយឥតគិតថ្លៃ 2= ទឹកត្រីមានរសជាតិឆ្ងាញ់ 3= ទឹកត្រីមិនឆ្ងាញ់ ☐ 4= ផ្សេងៗ បញ្ជាក់៖.....
31 ឥឡូវនេះ ខ្ញុំសូមសួរអ្នកអំពីគំនិតរបស់អ្នកស្តីពីទឹកត្រី ដែលអ្នកបានបរិភោគក្នុងអំឡុងពេលការសិក្សា (៦ខែកន្លងមក)	
31a) តើអ្នកចូលចិត្តរសជាតិទឹកត្រីដែលអ្នកបានបរិភោគក្នុងអំឡុងពេលសិក្សាដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 31 c)** ☐
31 b) ប្រសិនបើចាស ហេតុអ្វី? **ពន្យល់ រួចទៅសំណួរ22. d)**	1= រសជាតិឆ្ងាញ់ 2= រសជាតិដូចទឹកត្រីដែលខ្ញុំតែងតែទិញ 3= រសជាតិដូចទឹកត្រីដែលខ្ញុំតែងតែធ្វើ ☐ 4= ផ្សេងៗ៖.....
31 c) ប្រសិនបើទេ ហេតុអ្វី?	1= ប្រែពេក 2= រសជាតិខុសពីទឹកត្រីដែលខ្ញុំធ្លាប់ប្រើ 3= រសជាតិដូចថ្នាំ ☐ 4= ផ្សេងៗ-បញ្ជាក់.....
31 d) តើពណ៌របស់ទឹកត្រីអាចទទួលយកបានដែរឬទេ?	1= ចាស→ **សំណួរទី 31 f)** 2= ទេ ☐
31 e) ប្រសិនបើទេ ហេតុអ្វី?	1= ពណ៌ចាស់/ក្រមៅពេក 2= ពណ៌ស្រាល/ថ្លាពេក ☐ 3= ផ្សេងៗ-បញ្ជាក់.....

31 f) ពេលខាងមុខ ប្រសិនបើទឹកត្រីដែលអ្នកបានទទួលក្នុងអំឡុងពេលសិក្សា មានលក់នៅក្នុងភូមិរបស់អ្នក តើអ្នកនឹងទិញវាដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 31 i)** ☐
31 g) ប្រសិនបើចាស ហេតុអ្វី?	1=រសជាតិឆ្ងាញ់ ☐ 2= ខ្ញុំគិតថាវាធ្វើអោយប្រសើរឡើងដល់សុខភាពគ្រួសាររបស់ខ្ញុំ 3= ផ្សេងៗ-បញ្ជាក់.....
31 h) តើអ្នកនឹងអាចទិញតម្លៃប៉ុន្មាន ចំពោះទឹកត្រីដូចបានចែកអោយ ដែលមួយដបមានចំណុះ៧៥០មីលីលីត្រដែរឬទេ?	☐☐☐☐ **រៀល** **ចប់សំណួរនេះ សូមរំលងទៅសំណួរ32**
31 i) ប្រសិនបើទេ ហេតុអ្វី?	1= ប្រៃពេក 2= រសជាតិខុសពីទឹកត្រីដែលខ្ញុំធ្លាប់ប្រើ ☐ 3= រសជាតិដូចថ្នាំ 4= ផ្សេងៗ-បញ្ជាក់.....
32 ឥឡូវខ្ញុំសូមសួរអ្នកអំពីរបៀបដែលគ្រួសារអ្នកបរិភោគទឹកត្រី	
32 a) នៅក្នុងគ្រួសាររបស់អ្នក តើអ្នកណាដែលបរិភោគទឹកត្រីច្រើនជាងគេបំផុត?	1. ម្តាយកុមារ 2. ឪពុកកុមារ ☐ 3. យាយកុមារ 4. តាកុមារ 5. ផ្សេងៗ-បញ្ជាក់:_____
32 b) ហេតុអ្វីបានជាគាត់ បរិភោគទឹកត្រីច្រើនជាងគេ?	1. គាត់ឃ្លានជាងគេបំផុត 2. គាត់ចូលចិត្តទឹកត្រីជាងគេបំផុត ☐ 3. គាត់ហូបច្រើនជាងគេ នៅពេលអាហារម្តងៗ 4. ផ្សេងៗ.....
32 c) នៅពេលដែលទឹកត្រីបានដាក់ក្នុងម្ហូប តើសមាជិកគ្រួសារទាំងអស់ហូបបរិមាណដូចគ្នាដែរឬទេ?	1= ចាស→ **សំណួរទី 32e)** ☐ 2= ទេ 3= ទឹកត្រីមិនប្រើក្នុងការចម្អិន→ **សំណួរទី 32e)**
32 d) ប្រសិនបើមិនដូច ហេតុអ្វី?	1. អ្នកធ្វើការច្រើនហូបច្រើន 2. ប្តីហូបច្រើន ☐ 3. អ្នកដែលចូលចិត្ត (សម្ល/ឆា/ខ...)ហូបច្រើនជាងគេ 4. ផ្សេងៗ.....
32e) នៅពេលអ្នកទិញទឹកត្រីនៅផ្សារ តើជាធម្មតាអ្នកចំណាយប៉ុន្មានសម្រាប់ទឹកត្រីដែលមានចំណុះ750មីលីលីត្រ?	☐☐☐☐ **រៀល** ៨៨= ប្រសិនបើមិនដែលទិញទឹកត្រី

33 ឥឡូវខ្ញុំសូមសួរពីការគិតរបស់អ្នកស្តីពីផលិតផលបញ្ចូលជីវជាតិ។ ផលិតផលបញ្ចូលជីវជាតិគឺជាអាហារដែលបានបន្ថែមជីវជាតិ និងរ៉ែ ដើម្បីធ្វើអោយប្រសើរឡើងដល់សុខភាព និងការពារជម្ងឺ។ ឧទាហរណ៍អាហារដែលមានបញ្ចូលជីវជាតិ គឺអំបិលបញ្ចូលជាតិអ៊ីយ៉ូត ដែលសម្រាប់ការពារជំងឺពកក។	
33a)តើអ្នកធ្លាប់ឮអំពីទឹកត្រីមានបញ្ចូលជាតិដែកដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 33f)** ☐
33 b) ប្រសិនបើធ្លាប់ តើឮពីកន្លែងណា?	1. ផ្សារ ឬអ្នកលក់ 2. អ្នកធ្វើការងារសុខភាព(អ្នកស្មគ្រ័ចិត្តសុខភាពភូមិ ឆ្មប វេជ្ជបណ្ឌិត គិលានុបដ្ឋានយិកា។ល។) ☐ 3. ឮពីអ្នកដែលអាចជឿជាក់បាន ដូចជា ប្រធានភូមិ 4. ពីមិត្តភក្តិ ឬសមាជិកគ្រួសារ 5.ផ្សេងៗ.....
33 c) តើអ្នកធ្លាប់ទិញទឹកត្រីបញ្ចូលជាតិដែកដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 33e)** ☐
33 d) ប្រសិនបើធ្លាប់ ហេតុអ្វី? **ពន្យល់ រួចទៅកាន់សំណួរ 33 f)**	1. វានឹងធ្វើអោយប្រសើរឡើងដល់សុខភាព 2. មានតែទឹកត្រីនេះ ☐ 3. អ្នកដែលអាចជឿជាក់បាន (គ្រួសារ មេភូមិ បុគ្គលិកសុខភាព)បានណែនាំអោយប្រើ 4. អ្នកចូលចិត្តរសជាតិវា 5. ផ្សេងៗ.....
33 e) ប្រសិនបើមិនទិញ ហេតុអ្វី?	1=ថ្លៃ 2= គ្មានលក់ ☐ 3= អ្នកមិនចូលចិត្តរសជាតិ 4= អ្នកមិនចូលចិត្តពណ៌ 5= ផ្សេងៗ.....
33 f) ប្រសិនបើទឹកត្រីមានបញ្ចូលទាំងជាតិដែក និងជីវជាតិដែលអាចធ្វើអោយប្រសើរឡើងដល់សុខភាពអ្នក (ជីវជាតិ B1) មានលក់ តើអ្នកនឹងទិញវាដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 33 h)** ☐
33 g) ប្រសិនបើចាស ហេតុអ្វី? **ពន្យល់ រួចរំលងទៅសំណួរ33 i)**	1. វានឹងធ្វើអោយប្រសើរឡើងដល់សុខភាព 2. អ្នកដែលអាចជឿជាក់បាន (គ្រួសារ មេភូមិ បុគ្គលិកសុខភាព)និងអាចណែនាំអោយប្រើ 3. គិតថាវាមានសុវត្ថិភាព និងគុណភាពខ្ពស់ជាងពីព្រោះវាមានការត្រួតពិនិត្យបានត្រឹមត្រូវ 4. អ្នកដទៃអាចទិញវា ☐ 5. ផ្សេងៗ.....
33 h)) ប្រសិនបើមិនទិញ ហេតុអ្វី? **ពន្យល់ រំលងទៅសំណួរ34**	1= វាទំនងជានឹងថ្លៃ 2= គាត់ចូលចិត្តធ្វើទឹកត្រីដោយខ្លួនឯង ☐ 3= គាត់ត្រូវតែធ្វើទឹកត្រីដោយខ្លួនឯង ពីព្រោះគាត់គ្មានលុយទិញទឹកត្រី 4= ផ្សេងៗ៖.....

33 i) តើអ្នកនឹងចំណាយលុយលើសប៉ុន្មានដើម្បីទិញផលិតផលនេះ (បើប្រៀបធៀបទៅនឹងទឹកត្រីដែលអ្នកតែងតែទិញ)?	_____រៀល

ផ្នែកទី4៖ ចំណេះដឹងស្តីពីកង្វះជីវជាតិB1 ជម្ងឺបេរីបេរី និងការចិញ្ចឹមទារកនិងកុមារតូច		
34. តើអ្នកធ្លាប់ឮអំពីជីវជាតិB1 ឬហ្សាមីន ដែរឬទេ?	1= ចាស 2= ទេ ☐	
35. តើអ្នកធ្លាប់ឮអំពីបញ្ហាកង្វះជីវជាតិB1 ឬជម្ងឺបេរីបេរី ដែរឬទេ?	1= ចាស 2= ទេ → សំណួរទី 41 ☐	
36. តើអ្នកដឹងអំពី អាការៈរោគនៃបញ្ហាកង្វះជីវជាតិB1ឬជម្ងឺបេរីបេរី ចំពោះទារកអាយុតិចជាង៦ខែដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 41** ☐	
37. តើអាការៈរោគនៃបញ្ហាកង្វះជីវជាតិB1 ឬជម្ងឺបេរីបេរី ចំពោះទារកអាយុតិចជាង៦ខែមានអ្វីខ្លះ?	a. ដង្ហើមញាប់ ☐ b. ចង្វាក់បេះដូងញាប់ ☐ c. ហើមដៃជើង ☐ d. ក្អួត ☐ e. នោមតិច ☐	f. ប្រកាច់ ☐ g. យំគ្មានសម្លេង ☐ h. មិនឃ្លាន ☐ i. ផ្សេងៗ.....
38. តើអ្នកការពារ/ព្យាបាលបញ្ហាកង្វះជីវជាតិB1ឬជម្ងឺបេរីបេរី ចំពោះទារកអាយុតិចជាង៦ខែ ដោយរបៀបណា?	a. ម្តាយគួរតែបរិភោគអាហារសំបូរជីវជាតិB1 ☐ b. ម្តាយគួរតែបរិភោគអាហារដែលមានបញ្ចូលជីវជាតិB1ដូចជាទឹកត្រី ☐ c. ម្តាយគួរតែលេបបន្ថែមគ្រាប់ថ្នាំជីវជាតិB1 ☐ d. ទារកគួរតែបរិភោគអាហារសំបូរជីវជាតិB1 ☐ e. ទារកគួរតែបរិភោគអាហារដែលមានបញ្ចូលជីវជាតិB1ដូចជាទឹកត្រី ☐ f. ទារកគួរតែលេបបន្ថែមគ្រាប់ថ្នាំជីវជាតិB1 ☐ g. ផ្សេងៗ.....	
39. តើអ្នកអាចប្រាប់ឈ្មោះអាហារដែលសំបូរ ជីវជាតិB1បានដែរឬទេ?	1= ចាស 2= ទេ → **សំណួរទី 41** ☐	
40. ប្រសិនបើចាស សូមប្រាប់ពីឈ្មោះអាហារដែលមានជីវជាតិB1ខ្ពស់? (សូមគូសចម្លើយទាំងអស់)	a. អង្ករសម្រូប ☐ b. ពពួកសណ្តែក ដូចជាសណ្តែកបាយ និងសណ្តែកបារាំង ☐ c. សាច់ជ្រូក ☐ d. គ្រឿងក្នុងសត្វ ☐ e. សណ្តែកសៀង តៅហ៊ូ និងផលិតផលធ្វើពីសណ្តែកសៀង ☐ f. ផ្សេងៗ.....	
41. តើទារកគួរបៅតែ**<u>ទឹកដោះម្តាយមួយតែមុខគត់</u>**រហូតដល់អាយុប៉ុន្មាន (បំបៅតែទឹកដោះម្តាយតែមួយមុខគត់ គ្មានទឹក ទឹកដូង ទឹកដោះគោ ឬអាហារផ្សេងៗទៀត)?	**ខែ** ☐☐ **88= មិនដឹង**	
42. តើកុមារគួរតែទទួលអាហារបន្ថែមក្រៅពីទឹកដោះម្តាយ នៅអាយុប៉ុន្មាន? (អាហារដែលផ្តល់ឱ្យកុមារ បន្ថែមទៅលើទឹកដោះ)	ខែ ☐☐ 88=មិនដឹង	
43. តើកុមារគួរតែបន្តបំបៅដោយទឹកដោះម្តាយ ជាមួយនឹងការផ្តល់អាហារផ្សេងៗទៀតដល់អាយុប៉ុន្មាន?	ខែ ☐☐ 88=មិនដឹង	

44. តើអ្វីខ្លះជាអាហារដំបូង ដែលកុមារគួរតែបរិភោគ ក្រៅពីទឹកដោះម្តាយ?	a. បបរកំប៉ុង ☐ b. បបរស ☐ c. បបរគ្រាប់គ្រឿង ☐ d. បាយអង្ករសម្រិត ☐ e. បាយចំហុយជាមួយអំបិល/សាច់/ទឹកត្រី/សម្ល/ផ្សេងៗ ☐ f. បាយពាតជាមួយអំបិល/សាច់/ទឹកត្រី/សម្ល/ផ្សេងៗ ☐ g. បន្លែ ឬផ្លែឈើពណ៌លឿង ☐ h. ស៊ុត ☐ e. ផ្សេងៗ.....
45. តើកុមារគួរតែចាប់ផ្តើមបរិភោគអាហារគ្រួសារនៅអាយុប៉ុន្មាន?	ខែ ☐☐ 88=មិនដឹង